JUL 1 1946

Sky and TELESCOPE

Carroll College Observatory

Vol. V, No. 9
JULY, 1946
Whole Number 57
25 cents

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Montana Observatory

Amateur Astronomy in Czechoslovakia

Birth of the Solar System

Miscellanea from Amateurs

Northern and Southern Star Charts

Montana Observatory

EVEN AN EARTHQUAKE can be of assistance to amateur astronomers. Such, at least, was the experience of astronomy enthusiasts at Carroll College, in Helena, Mont. Back in 1935 the college had a telescope but no observatory to house it, although plans for such a building had been drawn up. Then came the series of earthquakes that shook Montana's capital city in the fall of 1935. Several tons of stone came down to earth when the quakes shook loose the stone gables of one of the college buildings. No longer needed when the roof was hipped to eliminate further earthquake damage, the stone — a native red porphyry — was seized upon as building material for the new observatory.

Under the leadership of Dr. Edward Neuman, head of the chemistry department, and an amateur astronomer, the building began to take shape. Most of the actual labor involved came from students, many of whom belonged to the astronomy club at the college. The building is now practically finished and becomes what is considered to be Montana's first astronomical observatory. (See the front cover.)

The ground floor of the two-story building is an octagonal waiting room, which measures about 18 feet from wall to wall. This room, which serves as a place to get warm before ascending a ladder to the unheated dome, is finished in knotty-pine paneling and Celotex ceiling. Through the center of the room rises a brick pillar, hidden from view by paneling, which rests on bedrock and which supports the telescope on the second floor.

The dome of the observatory is of galvanized iron sheeting over a wooden frame and has an inside diameter of 15½ feet. The curvature begins 3½ feet above the level of the second floor. The slit for the telescope in the dome consists of a single sliding cover. Rolling on 12 eight-inch cast-iron wheels mounted on ball bearings, the dome can be easily moved by one operator.

Like the observatory, the telescope is the work of amateur astronomers. Two students, Custer Baum and Andrew Richardson, built the 12-inch f/8 mirror as part of their senior thesis in 1935. At present, a wooden tube nine feet long is used for the telescope, but a cork-lined tube is contemplated. The mounting is of the conventional German equatorial form.

The telescope and the observatory have been of great assistance in furthering interest in the stars. Dr. Neuman has instructed over 300 students in astronomy courses utilizing the telescope. A number of students made accurate observations of the solar eclipse that was total near Helena last July 9th. Last fall the college invited the townsfolk to observe the moon and other celestial objects through the telescope. With about 80 Helena residents turning out for the initial observations, the college was encouraged to continue the series.

JAMES R. WHITE, Librarian
Carroll College

Sky and TELESCOPE

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The Editors Note . . .

THIS SUMMER may well be taken as marking the return to full peacetime activities of amateur astronomers who for many years have been able to devote only a restricted number of hours to their hobby. The Detroit Convention is receiving enthusiastic support, with reservations made by amateurs living at great distances. Next month at Springfield, Vt., the telescope makers from far and near will again hold their famous Stellafane conclave.

Everywhere we hear of amateur groups resuming their regular programs and scheduling field trips, and of new groups being formed. The list of societies in Here and There with Amateurs published last month is larger than ever, even though there are some organized groups which have not sent in the necessary information. There is no obligation incurred for this listing, except to keep it up to date (local group secretaries, please note).

Abroad, too, interest in amateur astronomy is rising rapidly. The British Astronomical Association has recently had a phenomenal increase in its regular membership, and Dr. Kopal's story of Czechoslovakia in this issue makes us realize that Americans are by no means the most enthusiastic nor numerous of amateur astronomers. Perhaps the Detroit convention will complete final plans for national organization of groups and individuals in the United States and thereby set going a movement which should help to bring many would-be amateurs solidly into the ranks of this hobby.

From advance-copy files we have selected for this issue as many reports of amateur activities as we could include in the space available; many of these communications have been held for some time for just such an opportunity. Amateur groups and individuals are especially invited to write concerning their programs and plans, the publication deadline being one month before the first day of the month of issue.

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BACK COVER: A portion of the moon near first quarter, from a Lick Observatory photograph taken with the 36-inch refractor by J. H. Moore and J. F. Chappell. The reproduction is reduced 10 to 7 from a 7.8 enlargement of the original negative. (See In Focus.)

SKY AND TELESCOPE is published monthly by Sky Publishing Corporation, Harvard College Observatory, Cambridge 38, Mass. Entered as second class matter, April 28, 1939, at the Post Office, Boston, Mass., under Act of March 3, 1879; accepted for mailing at the special rate of postage provided in Paragraph 4, Section 538, Postal Laws and Regulations.

Subscriptions: $3.00 per year in the United States and possessions, and to members of the armed services; Canada and all countries in the Pan-American Postal Union, $3.50; all other foreign countries, $4.00. Make checks and money orders payable to Sky Publishing Corporation. Send notice of change of address two weeks in advance. Circulation manager: Betty G. Dodd.

Editorial and general offices: Harvard College Observatory, Cambridge 38, Mass. Unsolicited articles and pictures are welcome, but we cannot guarantee prompt editorial attention, nor are we responsible for the return of unsolicited manuscripts unless return postage is provided by the author.

Advertising director: Fred B. Trimm, 19 East 48th Street, New York 17, N. Y.; ELdorado 5-5750.

Amateur Astronomy in Czechoslovakia

By Zdenek Kopal, *Harvard College Observatory*

IT MAY BE SOMEWHAT of a surprise for most readers of *Sky and Telescope* to learn that the republic of Czechoslovakia has emerged from the war with what seems to be the largest proportional group of organized amateur astronomers in any country — the reports reaching us from the other side of the ocean do not admit of any doubt.

The beginnings of amateur astronomy in Czechoslovakia date back to the second half of the 19th century and were as modest as the life of the country, then under foreign rule. Students of variable stars may remember Vojtech Safarik (1829-1902), a professor of chemistry by vocation, whose careful and numerous observations of variable stars, extending over several decades and at a time when these objects were paid but scant attention everywhere else, have outlived his contributions to chemistry. Historians of astrophotography may recall Josef and Jan Fric, who late in the last century were among the first in Central Europe to photograph celestial objects systematically.

The Fric brothers are worth more than a brief note, if it were only for the fact that they narrowly missed becoming Americans. Their father, exiled for revolutionary activities in 1848, contemplated emigrating to the U. S. about 1860. With his family he got as far as Paris, where the future amateur astronomers were born. Eventually, the family was permitted to return to Praha. Astronomy had attracted both brothers early in their lives. From 1880 on there was scarcely a comet which they had not photographed repeatedly with their homemade reflector. A photographic record of a total lunar eclipse in 1885 earned them a gold medal at an international photographic exhibition in Oporto.

It was the ambition of both brothers to erect their private observatory; but in 1897 it befell to Josef Fric, then a prosperous manufacturer of precision instruments, to erect it as a memorial to his younger brother Jan, who died prematurely that year. This observatory is situated near the town of Ondrejov, on top of a hill about 1,700 feet above sea level and 30 miles southeast of Praha. It is there that Professor F. Nusl, in collaboration with Josef Fric, made his pioneer studies of refraction anomalies, developed the circumzenithal instrument, and took part in the international latitude measurements in 1927. A year later, on the occasion of the 10th anniversary of Czechoslovak independence, the aging amateur astronomer donated his whole observatory to Charles University in Praha. Passing years have not diminished Fric's interest in astronomy. The writer got a letter from him shortly before Pearl Harbor, asking Dr. Shapley's opinion about the outlook for scientific work at observatories of modest size. In September, 1945, before the restoration of mail service permitted a reply, the old gentleman passed away, in his 85th year.

Ondrejov Observatory is situated in unusually attractive surroundings. One dome houses a modest 8-inch refractor, the lens of which was made almost a century ago in Cambridge, Mass., as a first masterpiece of the then unknown amateur optician named Alvan Clark. As is well known, Clark sold his first successful lens to a British amateur astronomer, the Rev. W. R. Dawes, who discovered with it so many new and close double stars that the reputation of the young Cambridge optician was at once established. It is perhaps less known that, after Dawes' death, this lens was purchased by Professor Safarik and made thus its way to Praha. After Safarik's passing, it came eventually into the possession of the Fric brothers, and it was then mounted at Ondrejov. The writer of these lines had frequent opportunity to use this telescope in his student days and can testify that its lens of superb optical performance — a modest forerunner of giant object glasses which the Clarks were to produce for leading American observatories — is still in active use.

The central dome of the Ondrejov Observatory, housing the 8-inch Clark refractor.

The western dome at Ondrejov houses an astrograph whose main lens is an 8-inch Cooke triplet, with which Josef Klepesta took on September 12, 1923, his well-known picture of a bright bolide in the neighborhood of the Andromeda galaxy.

Fifty years ago, men like Safarik and the Frics were still rare in Czechoslovakia; but after the beginning of this

Left: A double astrograph of the Ondrejov Observatory, designed and built by Josef and Jan Fric. It carries an 8-inch and a 6-inch lens, both f/4.5.

Right: The housings of the circumzenithal instruments with which Professor F. Nusl (entering the open door) did much of his pioneer astrometric work.

The great bolide of September 12, 1923, was photographed with the galaxy in Andromeda, M31, by Josef Klepesta at Ondrejov Observatory.

century their number began to grow by leaps and bounds and, in 1917, they felt strong enough to found an astronomical society in Praha. This coincidence with the dark days of the first World War was no accident, for in just such times people are more apt to take refuge from terrestrial vicissitudes in the pursuit of celestial exploits — a phenomenon that recurred, 25 years later, during the second World War. The accompanying photograph shows some members of the "old guard" who participated in founding the Astronomical Society of Czechoslovakia.

In its first three years, the society published a modest quarterly (*Vestnik*), which in 1920 had changed into a monthly journal named *Rise Hvezd* (The Realm of the Stars). This is now in its 27th volume as publication was not interrupted by the war. Although the language of this journal presents an effective barrier to its use in non-Slavic countries, its original articles are as a rule accompanied by English or French summaries. The illustrations frequently exhibit local achievements in telescope making or celestial photography.

In 1928, the Czechoslovak Astronomical Society erected its own observatory at Petrin hill overlooking the capital of Praha, and this has become the society's permanent headquarters. The observatory is named for General Stefanik, a patriot who began his colorful career as an astronomer. It is owned partly by the municipality of Praha and operated by the society. On certain hours each day it is open to the public; other times are reserved for observations by members of the society, mainly on the sun and related phenomena, meteors, and variable stars. It was in the variable star section that the present writer in his high school days began his astronomical career. In 1936, the society equipped and sent out solar eclipse expeditions to Russia and to Japan — the first such expeditions ever sent under the Czechoslovak flag.

The middle '30's have witnessed a gradual ramification of the society in the provinces. Active branches sprang up at Ceske Budejovice in south Bohemia, at Hradec Kralove in northeast Bohemia, and at Bratislava in Slovakia, and soon their own observatories began to compare in size with Stefanik. In 1938, the national society enrolled almost 1,000 organized amateur astronomers.

The Munich partition and war turmoil apparently turned people more strongly than ever to astronomy, so that in 1945, although its observatory had been badly damaged, the Czechoslovak Astronomical Society emerged with well over 2,400 members. As there are now only 11 million Czechoslovaks living in Central Europe, this is probably the highest percentage of amateur astronomers to be found at present in any country of the world.

Today, as for the past 24 years, the president of the society is Professor Nusl, director-emeritus of the Czechoslovak National Observatory and sometime vice-president of the International Astronomical Union. Society vice-presidents now are Dr. Bohumil Sternberk of the National Observatory, also editor of *Rise Hvezd,* and Karel Novak, a veteran observer of lunar occultations. The present secretary, Jaroslav Vlcek, a member of the 1936 eclipse expedition to Russia, is American-born; his parents emigrated to their old country from Pittsburgh after the last war. At present, members of the society are most anxious to catch up with the progress of astronomy abroad during the years of their isolation and

The earliest amateur astronomers of Czechoslovakia. Even the angels adorning some 18th-century Praha baroque churches minded astronomy.

The "old guard" of Czech amateur astronomy meets at Klepesta's. On the left (standing) we see Josef Klepesta, a publisher, veteran celestial photographer, and for more than 20 years secretary of the society. Next to him stands Karel Andel, a retired school director, proud of a lunar crater named after him in recognition of his fine work in selenography; and Judge Dr. Karel Novotny. Sitting (from left to right) are Dr. Hubert Slouka, of the National Observatory, a veteran eclipse observer; Dr. Jan Sourek, sometime vice-president of the society; Josef Sipek, and Ing. Victor Rolcik, one of the best amateur telescope makers in the country.

are eager to get acquainted with new literature.

Observing sections of the society are resuming their activities. One variable star observer, Zavis Bochnicek, deserves special mention. In June, 1936, at the age of 16, he had the good luck to be one of the independent discoverers of Nova Lacertae 1936. Encouraged by this success, he undertook astronomy seriously and, in 1939, joined the University to become a professional. War interrupted his work, however, and in 1942 he was taken to Germany on forced labor. By now he is back at Praha and at his telescope; for a recent I.A.U. Circular from Copenhagen (No. 1029) discloses him again as one of the independent discoverers of the recent outburst of T Coronae Borealis.

Although Bochnicek appears to be the most promising observer of variable stars in Czechoslovakia, he is too young to have accumulated the greatest number of observations. That honor belongs undoubtedly to Frantisek Kadavy, a curator of the Stefanik Observatory, who lives at Petrin and has the best opportunity to use the instruments.

A survey of amateur astronomy in Czechoslovakia would not be complete without mentioning Dr. Antonin Becvar, probably the leading amateur astronomer of his country today. Since his boyhood he has been an ardent telescope maker, and with a few enthusiastic friends he built a good-sized private observatory in his home town of Brandys nad Labem — building, dome, mounting, and mirrors. In 1937, Dr. Becvar, then a meteorologist by profession, was detailed to the High Tatra Mountains in Slovakia as a government climatologist. During the war he succeeded — only he knows how — in persuading the Slovak government to erect a new modern astrophysical observatory near Skalnate Pleso (Rocky Lake), at an altitude of nearly 6,000 feet. Its main instrument is a 24-inch Zeiss reflector of three meters Newtonian focus and 10 meters Cassegrainian. This instrument was originally at Stara Dala (O'Gyalla) Astrophysical Observatory; it was removed in time before the approaching fury of war. The instrument in the smaller dome is probably closer to Becvar's heart: it is his old homemade telescope with 10- and 8-inch mirrors that followed him to High Tatra from Brandys.

The observatory at Stara Dala was disbanded in 1942 while in Hungarian hands, and although now back in Czechoslovakia, no attempts are being made to restore it. The name of Stara Dala may therefore be omitted henceforth from all lists of active observatories, with Skalnate Pleso its natural heir. Dr. Becvar, who now directs this latter institution, will be happy to receive all publications that before the war were being sent to Stara Dala.

Becvar is an assiduous observer who probably has slept few clear nights in the past 20 years; his recent record bears witness of this. During the war years, he discovered independently at Skalnate Pleso Comet 1942a, a feat rewarded by a Donohoe comet medal of the Astronomical Society of the Pacific — the first such award to go to Czechoslovakia. Quite recently, Dr. Becvar and his assistant, Milan Dzubak, reported the discovery of a new active meteor swarm on December 22, 1945, which was subsequently identified by Rigollet with Comet Tuttle. (See News Notes in this issue for a note about this meteor swarm, and about a newly discovered comet reported by Dr. Becvar.)

In conclusion, it appears that although professional astronomy in Czechoslovakia may still have a long way to go to live up to its past — for Praha was once the city of Tycho and Kepler — a widespread interest in astronomy, as represented by solid ranks of membership in the national astronomical society, is full of promise and prepares a fertile ground on which good harvest may one day be expected.

A view of the new astrophysical observatory built during the war at Skalnate Pleso in the High Tatra Mountains. The main dome on the right houses a 24-inch reflector.

NEWS NOTES

By Dorrit Hoffleit

COMET PAJDUSAKOVA-ROTBART

At 2 a.m. EST, on May 30th, an amateur astronomer in Washington, D. C., David Rotbart, used his binoculars for viewing the heavens and discovered a 6th-magnitude comet in Cygnus. A day later word was received at Harvard from Copenhagen that an astronomer at Skalnate Pleso Observatory, Czechoslovakia, had already found the comet at 7:30 p.m. EST on May 29th, when it was reported as only 8th magnitude. The comet has hence been named for the two independent discoverers, Ludmila Pajdusakova and David Rotbart.

The comet had a tail less than a degree long and moved rapidly across the sky. Dr. L. E. Cunningham, at Berkeley, Cal., computed its orbit, from which it appears probable that this comet is the same as Comet 1862 II, which had not been observed since that year because of its long period of travel around the sun. Indeed, the early orbit had not deviated sufficiently from a parabolic path for a prediction of the period to be made.

At perihelion passage on May 11th, the comet was about 95 million miles from the sun, or at about the same distance as the earth. As it traveled across Hercules and Bootes in early June, it lost brightness rapidly, and the full moon in the middle of the month further interfered with its observation in small telescopes.

TELESCOPE FOR CLIMAX

The Bausch and Lomb Optical Company has presented a well-equipped 10½-inch telescope to Harvard University, to be used for solar studies at the High Altitude Observatory operated jointly by the University of Colorado and Harvard. The telescope, fitted with special filters and motion-picture camera attachments, will record rapid changes on the sun.

This much appreciated gift will, however, be missed by students and visitors in Rochester who have enjoyed the use of the instrument for the past 30-odd years when it was mounted on the roof of Bausch and Lomb's six-story building there.

SOLAR CLOUDS BOMBARD EARTH'S IONOSPHERE

Clouds of charged particles released from the sun during solar disturbances, upon reaching the earth, come into the range of newly developed radio probes at heights of 500 to 600 miles above the earth. The particles move at speeds of about one mile a second until they fuse with the ionized layer about 180 to 250 miles high. Occasionally they appear to break away from that layer and to move out again at about the same rate.

These facts have been ascertained by the use of a panoramic ionospheric recorder that sends out strong pulses of radiation at adjustable intervals of five to 30 seconds. The method has been developed by radio technicians on the staff of the Carnegie Institution of Washington, and is reported by Science Service.

The pulse-ranging technique used is similar to that of radar, but the new equipment measures atmospheric phenomena too swift for detection by earlier devices. A motion-picture camera records the images on a cathode-ray tube as the pulses are reflected from high above the earth.

METEORITE FALLS REPORTED

Several cases of meteorites striking populated regions have recently made news. It is hoped that correspondents will send in further information on the Santa Ana, Mexico, and Sturgis, S. D., accounts.

The Santa Ana fall is reported by United Press from Mexico City on May 16th. It states that a meteorite fell on a ranch in the village of Santa Ana in the state of Nuevo Leon on Sunday, May 12th, destroying many houses and injuring 28 persons.

The second case was reported on June 1st by both United Press and Associated Press. It appears that E. V. Morrill and his family slept so soundly that they heard nothing of a cataclysm which produced an enormous hole in their yard during the night. The hole was about 35 feet deep, measuring 18 by 12 feet, and huge rocks are reported to have been sheared off. Neighbors reported a "blinding flash" about midnight and thought it too bright to be lightning. The dispatches state that two geologists from the South Dakota School of Mines have been sent to examine the cavity.

A third case goes back to 1938, on June 16th, when a shower of stones fell at Pantar, Lanao, Philippine Islands. It is amazing that so spectacular a phenomenon as that described by an observer, H. J. Detrick, of Dundee, Ore., should have gone unreported for eight years. His account in *Popular Astronomy* reads in part:

" . . . All eyes in the [Camp] Keithley group were turned upon this non-terrestrial object, for at least another 2 minutes, as it sped on in its course, emitting continuously ringlets of smoke; then, when a few degrees west of north of Dansalan (horizontal distance, 9 km.; elevation above sea-level, 20 km.), the career of the celestial object ended in awful violence, with terrific explosions and thunderous vibrations that caused rattling of doors and windows thruout the town and countryside; a huge gray-and-black cloud, filled with bursts of flame, formed and spread out as a result of the mighty explosions; and this cloud persisted for more than 30 minutes."

At Pantar, nine kilometers north of Dansalan, Moro laborers working in the rice fields observed many objects falling from the sky, and Mr. Detrick reports that 16 pieces were later recovered, one as much as 20 inches in the ground. This deepest one fell with four others, about 10 steps from where two Moros stood; when recovered it was "still warm, smelling like burned gunpowder."

It is hoped that Dr. H. H. Nininger, of the American Meteorite Laboratory in Denver, who received this amazing report from Mr. Detrick, will have an opportunity to investigate the fall and to examine the meteorites.

NEW METEOR SHOWER AND OLD COMET

Through the bureau of astronomical telegrams at Copenhagen, we hear about an unexpected shower of meteors seen from the observatory at Skalnate Pleso, Czechoslovakia. For over four hours on the night of December 22, 1945, meteors fell from a radiant in Ursa Minor, for about 10 minutes at the rate of 169 per hour. In addition to a possible association with the comet of 1792 II, proposed by Director A. Becvar, a probable connection with Tuttle's comet is suggested by M. Rigollet, of the Paris Observatory. The secular decrease in perihelion distance of this comet might give rise to an important meteor shower observable in late December.

In H. Faye's *Cours de l'Astronomie*, we note that the comet discovered by Tuttle in 1871 had been first observed as Comet 1790 II. At its most recent return in August, 1939, Tuttle's famous comet was only an object of the 17th magnitude.

SODAR

A radar device for helping predict the weather has been reported by two Bell Telephone Laboratories physicists, G. W. Gilman and F. H. Willis. Sodar transmits sound waves vertically upward and records the patterns of the echoes bounced back from the atmosphere. Since the echo-pattern depends on the temperature, humidity, and air velocity, the device yields data correlated with the weather. For example, the volume of sound reflected increases greatly when hot and cold air masses are being mixed violently — a storm condition.

ASTRONOMICAL ANECDOTES

COMETS, GODFREY AND FRANKLIN

THE HERSCHELS are the long-lived astronomers mentioned last month. Sir William lived 84 years, his sister Caroline lived 98 years, Sir John lived 79 years.

And Caroline it was who discovered eight comets. One of them, which she saw on November 7, 1795, was later identified with one observed in January, 1786, by Mechain at Paris. Thulis at Marseilles saw it in October, 1805, and in November, 1818, Pons saw it again.

Encke calculated the orbit of the comet seen by Pons, and found that it seemed to follow an elliptical path of period about 3½ years. He identified the comets of 1786, 1795, and 1805 with it, the other seven apparitions being unobserved. Because the work of Encke had been so exhaustive, the name Encke was attached to this comet, contrary to the usual practice of using the names of one or more discoverers. This object has been seen at more apparitions than any other comet; not one appearance since 1819 has been missed. It has the shortest known period of any comet, about 3.3 years.

In 1788, Caroline discovered a comet which now appears to be the one of longest confirmed period. On July 29, 1939, Rigollet discovered a comet of sufficiently close agreement with Miss Herschel's comet 1788 II that I believe no one challenges Dr. Cunningham's identification of the two. The period is 151 years.

In Philadelphia, about 216 years ago, there lived one Thomas Godfrey, a glazier, who had only enough education to read and write. He became interested in mathematics and, finding that only in Latin could the best works be read, he learned that language. In a letter from a responsible citizen, James Logan of Philadelphia, to Edmund Halley, dated May 25, 1732, we read that Logan met Godfrey first when he came to Logan's house to borrow Newton's *Principia.*

Benjamin Franklin speaks rather disparagingly of Godfrey: "He is a self-taught mathematician, knowing little out of his way, and not a pleasing companion, because, like most great mathematicians I have met, he expected precision in everything, and was ever denying and distinguishing upon trifles, to the disturbance of all conversation." Franklin's excellence lay in strong natural sense, and simple, well-conceived experiments; he was probably a bad listener to anyone who knew mathematics better than he did.

An old manuscript which I have seen says, "In 1730, Godfrey, to obviate the difficulties in using Davis's quadrant, made some improvements in the mariner's bow, and afterwards devised the double reflecting quadrant. The ingenuity and scientific combination which he exhibited in these instruments make it remarkable that we have no account of anything else which was produced by him, and this is possibly to be attributed to the habit which he unfortunately indulged of intemperance. Without venturing to palliate such conduct, we may, without injustice attribute it, at least partially, to the circumstances in which he was situated." Godfrey died in December, 1749.

Caroline Lucretia Herschel (1750-1848), discoverer of comets.

In 1730, Godfrey attached two mirrors to a quadrant in a way familiar to those who use sextants. The instrument was tried on a voyage on the sloop *Truman,* John Cox master and George Stewart mate, to Jamaica and return, and was found to be quite satisfactory. Affidavits were sent to the Royal Society, and it was eventually allowed that Godfrey's invention was independent of that of Hadley; both of them were later than Isaac Newton's suggestion of the same instrument. According to a reference which at the moment I cannot verify, Godfrey received a reward of some value for his work but, because the love of liquor was one of Godfrey's vices, the gift was made in the form of a complete houseful of furniture.

It has always seemed to me most amazing that Benjamin Franklin, who dabbled in almost everything, including meteorology, says no word about astronomy, as such. Why was he not interested in the stars? There were some good astronomers among his friends — David Rittenhouse, Provost Smith, even Thomas Jefferson was interested — but Franklin apparently never looked at the most exciting natural phenomena — the stars and planets. Maybe he did look, once, and felt uncomfortable!

R.K.M.

AN ARTIFICIAL SATELLITE

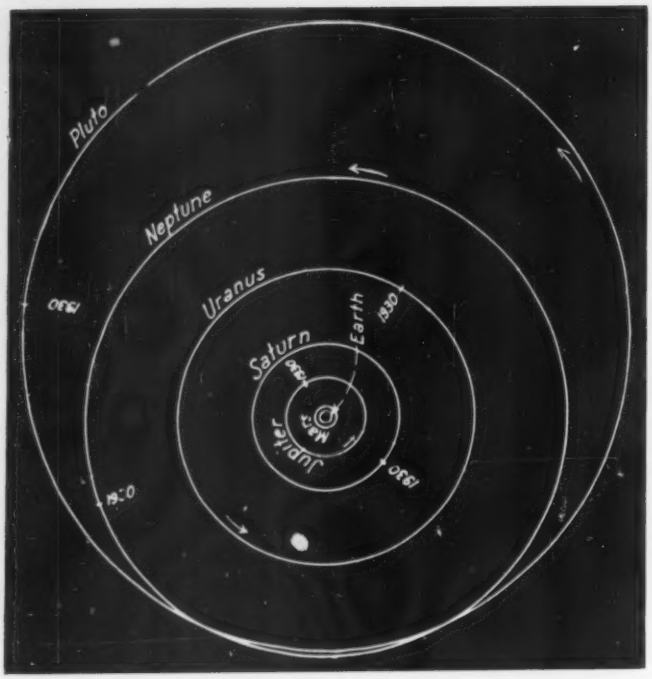
The astronomical possibility of creating and putting into operation a second "moon" of the earth was suggested to the American Psychiatric Association in Chicago, on May 29th, by Dr. Harlow Shapley, director of Harvard College Observatory. He said that probably, with enough money and time, a radio-equipped rocket-controlled projectile could be sent a few thousand miles above the earth. Once there and started in the right direction at the correct speed, such a projectile would continue to travel around the earth under the influence of gravity alone.

Others have suggested such a device for creating a perpetual "eclipse" of the sun; for maintaining a really "high-altitude" observatory; for the study of cosmic rays; and for making astronomical observations in the extreme ultraviolet and infrared regions where the atmosphere cuts off incoming radiation. Perturbations in the orbit of the projectile caused by the moon and sun could be corrected by the radio controls.

As a forerunner to eventual success in creating such an artificial satellite, plans are already being made for holding V-2 rockets at their peak altitudes (some 120 miles) for a short time while solar-spectrum and cosmic-ray observations are made. In the recent tests at White Sands, N. M., a 16-inch telescope has been used for visual tracking of these rockets during their flights into the ionosphere.

MORE PLANETARY SPECTRA

Infrared spectra of the planets are being obtained at the McDonald Observatory in Texas; light of wave lengths of the order of one micron (10,000 angstroms) is photographed by means of a mirror and a grating plated with a thin coating of gold, according to facts Science Service obtained from the director, Dr. Otto Struve. Recent work has revealed hitherto unknown bands of carbon dioxide around Venus, and of ammonia around Jupiter. The actual observations were made by two University of Chicago staff members, Professor G. Herzberg, authority on the structure of molecules, and Dr. W. A. Hiltner, assistant director of the Yerkes and McDonald observatories.



The orbits of the planets from the earth outward are shown here. It is evident none of them except the orbit of Pluto departs much from a nearly circular form.

BIRTH OF THE SOLAR SYSTEM

By Robert R. Coles, *Hayden Planetarium*

THE QUESTION OF ORIGINS has fascinated man during all ages. Before the dawn of history legends had been invented explaining the birth of the sun and moon, many of which have survived through the centuries and may be found today in various collected works.

As one looks skyward on a clear, moonless night, this question of origins comes very naturally to mind. We wonder not only about the stars but also about the sun and planets — our own corner of the universe. Has the solar system existed forever as we know it today? Obviously it has not. On all sides we have discovered ample evidence that there is a universal evolution quite as surely as there is an evolution of the geological, animal, and plant world here on the earth. But in the case of the sun's family, the clues are less apparent and the story is very much harder to interpret.

The inquisitive reader turns to texts on astronomy for answers to his questions. But after searching through many volumes it becomes apparent that there are no final answers to the solar-system problem.

Surprising as it seems, modern astronomers experience greater difficulty in finding a satisfactory theory that explains the origin of the solar system than did their predecessors of a century ago. This is not hard to understand, however, when we consider the number of observational facts that have been discovered and the advances that have been made in a better understanding of the dynamics of the solar system. Any theory to be accepted today must be in harmony with these facts if it would meet with the approval of astronomers.

One fact that becomes immediately apparent is that the solar system represents an orderly arrangement of component parts. This is true not only of its structure but also of its behavior. The sun and its family of planets form a unit of organization whose parts behave according to the laws which we derive from the concept of gravity. The three laws discovered empirically by Kepler describe the velocity-period-distance relations of the planets. Kepler's laws are stated and discussed in nearly all astronomy textbooks.

Closer scrutiny reveals the major planets traveling around the sun in orbits of low eccentricity that are not greatly inclined to that of the earth. The most notable exception is Pluto, whose orbit is inclined about 17 degrees to the ecliptic. And all of the major planets move in the same direction around the sun. Less complete is our knowledge of planetary rotations, but in nearly all the known cases the planets rotate in the same direction that they revolve around the sun. And, with few exceptions, the satellites revolve in a similar direction around their primaries. The sun itself rotates on its axis from west to east as do most of the planets. All this suggests that these components of the solar system must have had a common origin.

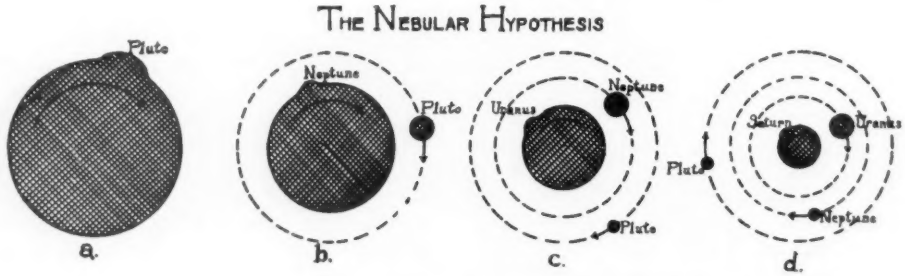
The problem is complicated, however, by the behavior of the comets. Moving in orbits of generally high eccentricity, these renegades travel at all angles to the ecliptic (the plane of the earth's orbit), some direct and others retrograde. Perhaps they belong in company with the few retrograde satellites as something annexed, and not fitting into the general orderly scheme of things. Meteors, sporadic and in swarms, also present features difficult to include in a single theory.

These facts have greatly influenced the reasoning of astronomers in search of clues that might explain the birth of the solar system. Could it be that this common motion was imparted by tremendous cosmic forces at the time of its origin? Are there any clues that suggest the nature of this force?

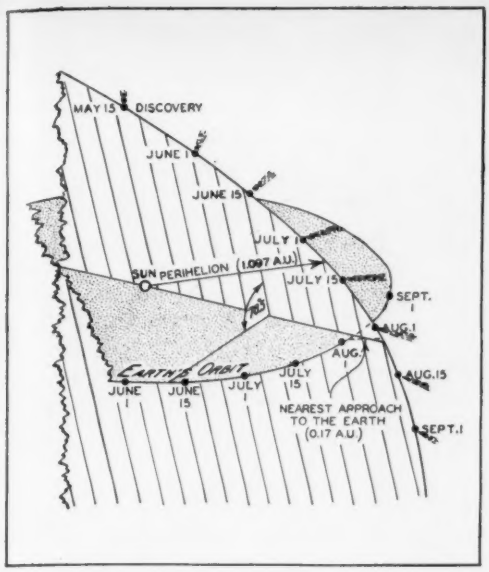
Just a century and a half ago (1796) the French mathematician, Pierre Simon Laplace, published his famous nebular hypothesis. This was really a scientific explanation based largely upon ideas that had been formerly suggested by Swedenborg, Kant, and others. This proposal was that at a time in the distant past the material now forming our solar system was a huge gaseous mass that rotated slowly. Then it slowly contracted and gradually became cooler. In time, the speed of rotation increased and eventually centrifugal force at the equator caused the mass to throw off a ring of gaseous material. Then, after shrinking further, it threw off another ring. And this process was repeated several times. Eventually, the mass within the rings condensed into the body that is our sun. And each of the rings in time collected into single bodies that were the planets, with some of the material for each planet giving rise to its satellites.

Laplace was a clever mathematician and had published many learned works

THE NEBULAR HYPOTHESIS



According to the old nebular hypothesis, gradual contraction of the original gaseous matter caused the formation of planetary rings, the outermost first. Drawing, courtesy Lyman Spitzer.



A theory about the origin of the solar system must explain the far-from-orderly behavior of comets. A schematic drawing of Peltier's comet of 1936 shows it cutting across the plane of the earth's orbit at an angle of nearly 80 degrees.

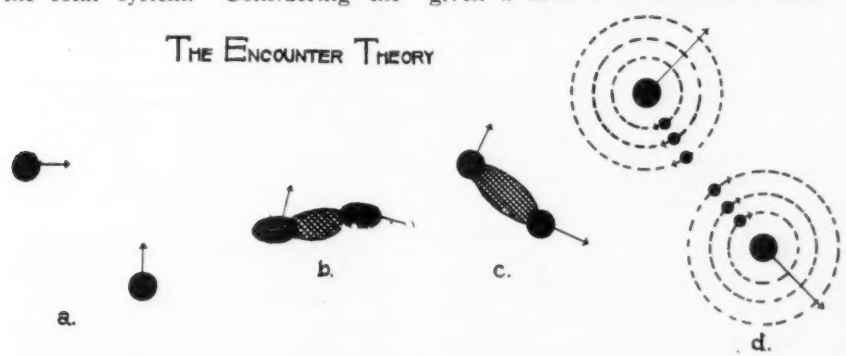
on mathematics. It has been said that this hypothesis appeared in the appendix to a popular book on astronomy which he had written, and was not considered of great importance even by its author. Yet his theory was generally accepted and taught as good astronomy for many decades after his death. Telescopic observation of the spiral nebulae seemed at first to offer visual evidence of other systems in the making. In those days, of course, there was no way of measuring the distances to such objects and no one could guess at their tremendous size or real nature.

Gradually, however, as man's knowledge of dynamics developed and more powerful telescopes were invented, serious objections were raised. In the first place it was shown that gaseous rings could not condense into a single planet, but would form large numbers of smaller bodies like the asteroids or the bodies that make up the rings of Saturn. Another serious objection has to do with the distribution of angular momentum in the solar system. Considering the small mass of the planets as compared with that of the sun, about one seventh of one per cent, the speed with which the outer planets revolve is far too great. Such a distribution of angular momentum could not possibly have developed under conditions assumed by the nebular hypothesis. Apparently, some external force must have been involved to achieve this result.

In searching for something that would represent this external force, attention was naturally directed to the stellar universe. The billions of individual stars in our galaxy are traveling in various directions at tremendous speeds. While the average distances separating these stars are reckoned in trillions of miles, it seems probable that occasionally one star may approach much nearer to one of its neighbors or, very rarely, even collide with another star.

At about the beginning of the present century, Chamberlin and Moulton proposed the hypothesis that the solar system originated as the result of a close approach to the sun by another star. In the beginning, the sun was a lone star, unattended by planets. Then some three billion years ago or more, it was approached by another wandering star from somewhere in the depths of the galaxy. Perhaps the two bodies approached each other at tremendous speeds, swinging close together and then parting company again. When at their nearest approach, each component drew great masses of matter from the other as a result of the tremendous gravitational forces involved.

For a brief interval, the most devastating chaos reigned in the immediate vicinity of the two bodies. But soon the turmoil began to subside and a dynamic pattern evolved. Some of the material pulled out of the sun left its gravitational field and either came under the influence of the other star or was lost in the depths of interstellar space. Much of the material fell back into the sun and by the force of its impact set that parent body rotating as it does now. Other material drawn out of the sun by this great tidal action was given a lateral or sidewise motion by



With the very close approach, or possibly actual collision, of two stars, here represented as being nearly of equal mass, the encounter theory suggests the formation of planets from material drawn from the stars. Drawing, courtesy Lyman Spitzer.

Such spiral nebulae as this one, M81 in Ursa Major, seemed 150 years ago to lend support to the nebular hypothesis. And it was not until about 20 years ago that their great distances were measured, and their stars resolved. It then became apparent that the solar system is exceedingly minute compared to a galaxy. Mount Wilson photo.

the passing star. It continued swinging around the sun in elliptical orbits, and eventually the billions of small particles that composed its substance built up about larger nuclei and formed the planets. According to this theory of Chamberlin and Moulton, the tiny particles that eventually formed the planets by a process of accretion are called planetesimals and the proposal is familiarly known as the planetesimal theory.

This suggestion was more in harmony with the observed data and better fitted the advanced knowledge of dynamics than did the nebular hypothesis. On the other hand, it was attacked by many astronomers on various grounds and soon a number of interesting variations appeared, suggested by eminent astronomers in this country and abroad. This is not surprising when we consider the tremendous scope of the theory. Minor details are hard to visualize in an event that occurred billions of years in the past.

One variation was suggested by the famous English scientists, Jeans and Jeffreys. According to them, the material was drawn out of the sun in an elongated cigar-shaped filament which eventually broke up to form the individual planets. In 1929, Jeffreys revised this hypothesis and suggested that there may have been more than a close approach of the sun and another star; it may have actually been a sideswiping or collision. The material forced out of each star eventually formed the planets, and the impact of the collision

imparted to them their motion of rotation.

These theories were soon subject to searching analysis by such astronomers as Henry Norris Russell, of Princeton University, who in 1935 raised serious objections to all encounter theories on dynamical grounds. While too involved to be discussed in an article of this nature, these objections were too great to be overcome. Among other things, they make it difficult to account for the existence of the planets Mercury and Venus at their present distances from the sun.

As stated in the latest edition (1945) of *Astronomy,* Vol. I, by Russell, Dugan, and Stewart: "... one hypothesis after another has been upset by more detailed dynamical and physical study. The problem is as puzzling as ever...." Meanwhile, new theories are continually being propounded. (*Sky and Telescope,* June, 1945, page 9, and August, 1945, page 9.) This problem of the birth of the solar system will always stand as a challenge to the astronomer, and it is hoped that some day a satisfactory solution may be found. In the meantime it is interesting to ponder some of the questions that such a problem brings to mind.

If our system of planets did result from the near approach or collision of the sun with another star, what became of that other star? Can it be one of the naked-eye stars that we see shining in the night sky? Probably we shall never know, but it would be interesting if one could point it out and say: "There is the star that once, in the dim, forgotten past, came swimming into our corner of the universe and tore the earth and its neighbor planets away from the sun." And if this star drew the planet stuff out of the sun, did it also acquire a family of planets similar to ours? This appears possible, but probably we shall never know.

Perhaps, some day in the distant future, another star will come our way and kidnap the planets, carrying them off to some remote corner of stellar space.

These are but a few of the dozens of ideas concerning origins that come to mind as one peers into the night sky or watches the parade of planets as they slide through the zodiac, changing their places against the background of distant stars from night to night.

CORRECTION

An error in editing the story, "Once in a Blue Moon," March, 1946, has been called to our attention by the author. Mr. Pruett writes that there was no "blue moon" in May this year, but that the next month in which two full moons will occur in one calendar month is August, 1947.

In Focus

THE PORTION of the moon on this month's back cover is quite different from the two preceding sections to the south, and considerably more "watery." There appear parts of a lake, three seas, two marshes, and a bay. **Lacus Somniorum** is the Lake of Dreams. The mares are **Serenitatis, Tranquillitatis,** and **Vaporum,** the Sea of Serenity, the Tranquil Sea, and the Sea of Vapors. **Palus Nebularum** is the Misty Marsh, and **Palus Putredinis,** the Putrid Marsh (certainly the least attractive name on the moon). The bay is **Sinus Medii,** the Central Bay, at the center of the moon as we see it. All of these names, except Sinus Medii (named by Maedler), were given by Riccioli about the middle of the 17th century.

Adjoining areas so far published are Plates II, III, and V. All the named features of this area are identified on the key chart. Spellings follow the International Astronomical Union's **Named Lunar Formations,** by Blagg and Mueller, and bibliographical information is from the British Astronomical Association publication, **Who's Who in the Moon.**

Apennines. An impressive range of mountains which forms a portion of the boundary of Mare Imbrium, only part of the range showing on this plate. **Mt. Hadley,** one of the four peaks which have been individually named, is about 15,000 feet high. It is called after John Hadley (1682-1743), who made the first really successful reflecting telescope.

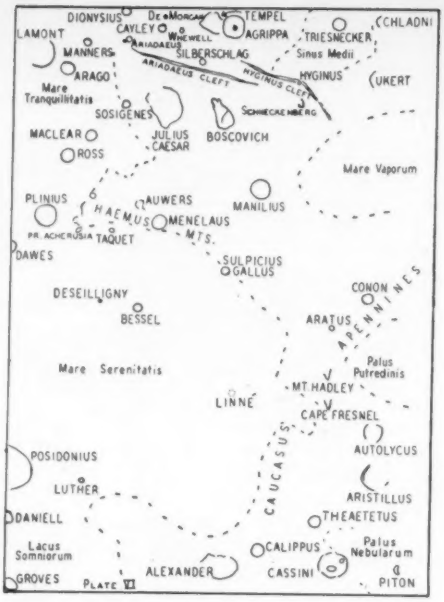
Aratus. This crater is about eight miles across, located in the Apennine highlands. It is named for the Greek poet of the third century B. C., author of one of the earliest extant descriptions of the ancient constellations.

Bessel. This 10-mile crater is the largest formation in Mare Serenitatis. It is named for the director of Koenigsberg Observatory, Friedrich Wilhelm Bessel (1784-1846), who measured the parallax of the star 61 Cygni in 1838. He also established the existence of the companion of Sirius.

Evening Star

In the green sky, over the hill's bow,
In the black branch of a twisted birch,
I saw Venus first.
Not planning to behold such show,
Just chancing to look west, a friend
Could not have pleased me more to speak
And greet me. An exultant streak
Of light ran underneath the star,
I could behold her sudden fire
Between the birch twigs, and a chance
Like this was not for every branch.
Now will tomorrow ever come
So I can stand again at dusk,
And pick the planet out, and wait
Until the darkness consecrates
Her beauty. I have found a reason
More than spring to celebrate,
Since Venus has again begun
Rising from the setting sun.

ELIZABETH JANE ASTLEY



Calippus. A ringed plain about 30 miles across, in the Caucasus, named for an early Greek astronomer, a pupil of Eudoxus.

Caucasus. A range of mountains bordering Mare Serenitatis, with its individual peaks ranging from 6,000 to 12,000 feet high. Goodacre reports that one mountain near Calippus is said to reach 21,000 feet.

Conon. A deep, conspicuous crater in the Apennines.

Haemus Mts. On the earth, this was the ancient name for the Balkan Mts. The lunar range is of lower average height than the Caucasus.

Linné. A small bright spot, one of the controversial features on the moon, where some observers have noted changes. Carl von Linné (1707-1778), also known as Linnaeus, was a Swedish botanist who introduced the Linnaean system of classification.

Manilius. A bright ring plain with a large central peak. Manilius was a Roman poet, author of the **Astronomicon.**

Mare Serenitatis. This lunar sea dominates this portion of the moon, and its borders are rather well defined by several mountain ranges. Goodacre states that its "coast line" measures 1,850 miles, and the sea has an area of nearly 125,000 square miles.

Menelaus. A bright crater in the Haemus Mts., about 20 miles across. A bright streak originates near it and extends across Mare Serenitatis to beyond Bessel. Menelaus was a Greek astronomer and geometer about the first century A. D., who made conspicuous contributions in both fields. His observations of occultations were used by Ptolemy and later by Albategnius to determine the value of precession.

Sulpicius Gallus. This eight-mile crater is named for a Roman consul, orator, and scholar, whom Cicero described as so eager for astronomy that he would sit up all night over his calculations.

Theaetetus. A ringed plain whose floor is depressed 7,000 feet below the tops of its walls. Named for an Athenian friend of Plato.

Amateur Astronomers

Recent Amateur Society Activities

Boston: The A.T.M.'s of Boston have resumed their meetings on the second Thursday evening of each month, at Harvard College Observatory, Cambridge, with a membership of 110.

During the war many of our members were employed in various kinds of war work and have gained a wealth of experience in mechanics and optics. A significant contribution to the war effort was made by those of our members who formed the nucleus of the Harvard Observatory Optical Shop, under the direction of Dr. J. G. Baker. In this shop many fine aerial cameras and special lenses were designed and made for the War Department and the National Defense Research Committee.

Our 20-inch mirror, which has been set aside for the past four years, is now ready for fine grinding and figuring. The construction of the telescope is under the direction of the following members: Chester Cook, grinding and figuring the mirror; Charles Avila, designing; Ed Lucy, pattern making; Frank Noyes, mountings and machine work.

The club workshop is open on each Thursday evening, and members gather to work on mirrors, diagonals, flats, mountings, and the like. Club membership dues are $3.00 per year, including a subscription to *Sky and Telescope*. Visitors are always welcome.

Elsa Naber

New York: April 17th was the date of the 19th anniversary dinner of the Amateur Astronomers Association. Various astronomical games preceded the dinner. Guests for the evening were Gordon A. Atwater, chairman and curator of the Hayden Planetarium; Dr. Orestes H. Caldwell, past president of the association; and G. Edward Pendray, secretary of the American Rocket Society, who was the chief speaker. His discussion was on "Astronomy in the Atomic Age." Awards of prizes and music and dancing concluded the evening's program.

On May 30th, over 50 members and friends took part in a field trip to the A.A.A. camera station at Sayville, Long Island. Weather was perfect for observing, swimming, grilled lunch, horseshoe pitching, kite flying, and a songfest. It was one of our most successful outings in years.

George V. Plachy

Milwaukee: The members of the Milwaukee Astronomical Society were fortunate to have at their monthly meeting on Thursday night, May 2nd, the internationally known astronomer, Dr. S. Chandrasekhar, of Yerkes Observatory. He gave as his lecture a review of recent ideas about the age of the universe.

About the middle of May, members held a "painting bee," giving their observatory a good going over and putting everything into shipshape condition. It seems that vandals make the mistake of thinking that an observatory is a good place to break into, and when that is done, they find that a 13-inch reflector is too large to haul away, so the next best thing is to make as much damage as possible.

Carl R. Griesbacher

Moline: The 10th anniversary of the founding of the Popular Astronomy Club, Moline, Ill., was celebrated by a banquet on March 20th. About 135 members and guests were present, attesting the steadily growing interest in this community in a study of the wonders of astronomy. To a large extent this interest is stimulated by the splendid facilities available to the club at the fully equipped Sky Ridge Observatory, situated in an ideal location easily accessible to all.

At the dinner, after remarks by various members of the club, Dr. Frank Hancock, president of the Fox Valley Astronomical Society of Geneva, Ill., spoke on "The Glory of the Out-of-doors." He emphasized the fact that character is developed to a fuller extent by close contact with the beauties of nature, as exemplified by the sky and earth.

R. S. Young

Washington: A recent trip of the Washington, D. C., National Capital Astronomers to Philadelphia included visits at the Franklin Institute and Fels Planetarium, the Cook Observatory and the Flower Observatory, both of the University of Pennsylvania. The day-long trip concluded with observing through the Flower 18-inch refractor.

Lee S. Richardson

THIS MONTH'S MEETINGS

Detroit: On July 5th to 7th, the Fourth National Convention of Amateur Astronomers meets at Cranbrook Institute of Science, with the Detroit and Northwest Detroit astronomical societies acting as hosts. Visits to two Michigan observatories are scheduled.

Indianapolis: "Sky Photography," by Victor Maier, is the scheduled lecture before the Indiana Astronomical Society, meeting at Odeon Hall, 2:15 p.m., Sunday, July 7th.

CONVENTION NOTES

As of the early part of June, no significant changes in the program of the Fourth National Convention printed in the June issue of *Sky and Telescope* are necessary. Reservations are still coming in, with Indiana, Kentucky, Maryland, Ohio, and Ontario now to be added to the regions represented.

Convention committee chairmen are: recorder, treasurer, and printing committee, George D. McCormick; exhibit chairman, Lloyd H. Sprinkle; transportation, William C. Oberem; registration, Mr. and Mrs. F. W. C. Jones; reception committee, Miss Berry, Mrs. Marriott, Mr. and Mrs. L. B. Christensen, Mr. and Mrs. C. S. Johnson; planetarium, Joseph Mazer; general convention and publicity chairman, Margaret Back.

Six junior members will act as guides for new arrivals at the Cranbrook School dormitory. Fingerposts and signs will direct the way to the dormitory and to the Cranbrook Institute of Science. Baggage can be dropped off before arrival at the institute for the Friday morning opening session, and members will point out assigned rooms.

Everyone is urged to register immediately upon arrival, as we expect to order chartered busses for the trips to the observatories, basing the seating capacity on the number of persons who have registered.

As the time draws near, all members of the host societies are looking forward with increasing enthusiasm to welcoming and visiting with convention delegates.

Margaret Back

AMATEUR WEATHERMEN OF AMERICA

With a 10-point program of activities and aims designed to be of particular interest to those who "want to do something about the weather," an organization known as the Amateur Weathermen of America is in process of being formed, with formal activities scheduled to commence this September.

Among the activities of the new organization will be: to serve as a national information service; to disseminate weather information as widely as possible; to foster the establishment of local weather stations; to organize clubs and workshops; to publish annually a *Weather Amateur's Handbook;* to establish a monthly magazine, *Weather* (planned to start in January, 1947); to maintain close liaison with the professional activities of the American Meteorological Society; to co-operate with the armed forces in maintaining a trained reserve of weather observers and forecasters.

Further information about the AWA may be obtained from Mr. David M. Ludlum, The Franklin Institute, Philadelphia 3, Pa.

MISCELLANEA FRO

Carl E. Wells at Fogus Observatory, Sacramento, Cal.

A Western Amateur

IT SEEMS UNFORTUNATE that the tribute to the late editor of the Observer's Page, Jesse A. Fitzpatrick, which appeared in the August issue last year, should come to us only after his death. The interesting account of his astronomical activities there given brings to mind a note in *Sky and Telescope*, February, 1942, concerning Leo J. Scanlon, an amateur in Pittsburgh who is very active. How much better it seems to be inspired by an account of the achievements of an outstanding amateur while he is still living rather than after he has passed from the scene.

The writer has had the pleasure of corresponding with both Fitzpatrick and Scanlon, but the touch with Scanlon has been the more vital "because I knew the man" as seen through the eyes of his friend, Fred Garland. It is hoped that a similar purpose may be served by notes on the achievements of another living amateur of whom the West Coast of the United States may well be proud.

Carl E. Wells, early an orphan, saw the seamy side of life in far-western cities as a boy. As a young man he played professional baseball successfully, married a Scotch lassie, Belia, who accompanied him through the hard conditions of life in the Alaskan mine fields. Their two children, Edith and Jack, were both born in the far north. For many years, Mr. Wells was a trainman with the Southern Pacific, and he is now a railway conductor running across the Sierra Nevada Mountains between Roseville, Cal., and Reno, Nev.

When his son conceived the idea of making a telescope mirror, Carl, as we all call him, grew intensely interested in the project. Jack's enthusiasm for telescopes was soon directed to other channels — he is now a graduate mining engineer who has engaged in war service — but his father's zeal for optics has increased with the years. Carl has completed many mirrors, including the 12½-inch at the junior college in Sacramento, Cal. His was the driving force which led to the mounting and housing of the mirror on the campus of that institution.

The moving spirits in the recently organized Sacramento Valley Astronomical Society have felt the impact of Mr. Wells' glowing enthusiasm for things astronomical, and it is safe to say that the organization would not have come into existence when it did without the foundation laid by him.

With very little formal schooling, Carl is self-educated in the best sense of the term. In his early manhood he sought the city library, and his wide reading has resulted in a genial philosophy of life which endears him to all who know him.

This western amateur is not satisfied with ordinary standards of mirror perfection. Every mirror is as perfect as his consummate skill can make it. The writer can testify to the exquisite definition which characterizes them all. His latest interest has been in the building of testing flats, one of the most exacting of optical manipulations. Now that the railroads are being somewhat relieved of their tremendous war load, Carl Wells hopes for more spare time to devote to his beloved hobby.

G. B. BLAIR
Reno, Nev.

Celestial Gleanings

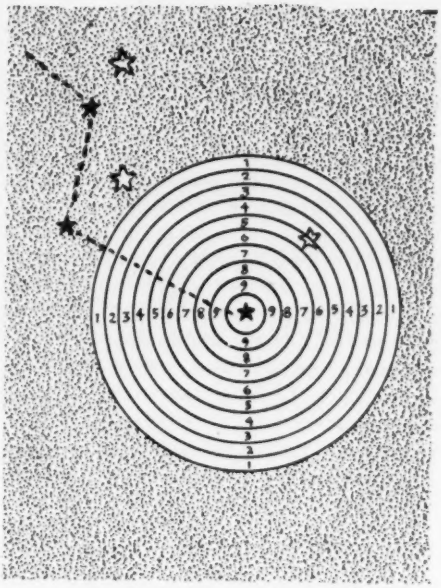
No sunspots have ever been seen at the poles of the sun nor beyond solar latitude 60°. Extremely few have been seen on the sun's equator. They occur mostly in latitudes 10° to 30° and occasionally between 30° and 60°, on either side of the equator.

Zodiacal constellations vary greatly in size where the ecliptic crosses them. The sun remains longest in Virgo, through which it passes for 45 days. Ophiuchus, not usually considered a constellation of the zodiac, contains more than twice as much of the ecliptic as does Scorpius.

The moon in its journey around the sky passes through 17 constellations at one time or another. Besides the 12 of the zodiac the moon may enter Cetus, Orion, Auriga, Sextans, and Ophiuchus.

Only four 1st-magnitude stars, Aldebaran, Regulus, Spica, and Antares, may be occulted by the moon. Including the five bright planets, this makes possible occultations of nine objects of the 1st magnitude or brighter.

EDWARD ORAVEC



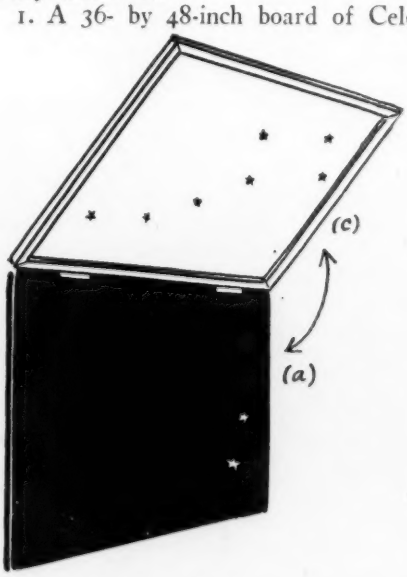
The scoring indicator here shows a star for which the thumbtacked position scores 4.

Astronomical Pinups

PRACTICAL constellation study in the daytime or under leaden skies may sound fantastic to the skeptic, but last year it proved to be of more than usual interest at the New York Amateur Astronomers Association annual outing at Blue Mountain Reservation, Peekskill, N. Y. Other amateur groups, as well as teachers, may find this system of studying the constellations of value.

A few simple "props" are required and a good draftsman is a decided but not essential asset in their preparation. They consist of:

1. A 36- by 48-inch board of Celo-



The master sheet (c) has the Big Dipper plotted, with the Pointers as key stars on board (a).

M AMATEURS

tex or other material easily receptive of thumbtacks. To represent a night sky this should be painted or covered a dark blue.

2. A dozen white thumbtacks, preferably with "star" heads.

3. Master sheets, 36 by 48 inches, showing the true relative positions of the brightest stars in some of the most popular constellations. Several star groups may be plotted on the same piece of transparent material — tracing cloth or plastic sheet — if different-colored inks are used.

4. A score indicator, also of transparent material, must be made. This may be of tracing cloth stretched on embroidery hoops, or of heavy plastic, 10 inches in diameter. Ten concentric circles with radii increasing by ½ inch are drawn on it and numbered outwards from 10 to 1.

The master sheet is pinned (or hinged if it is stretched on a frame) on top of the board. It is then raised and two star thumbtacks are placed on the board in the correct position of any two stars as indicated by the master sheet. The master sheet is now swung up and over so as not to be visible to the contestants, and individuals in turn are handed other star thumbtacks and invited to complete the constellation. A time limitation and scoring penalties for "corrections" may be introduced.

At each completion the master sheet is swung back over the face of the board, and the amount of error of the relative positions of the pinup stars may be measured by holding the transparent indicator with its center over the true position of any star on the master sheet.

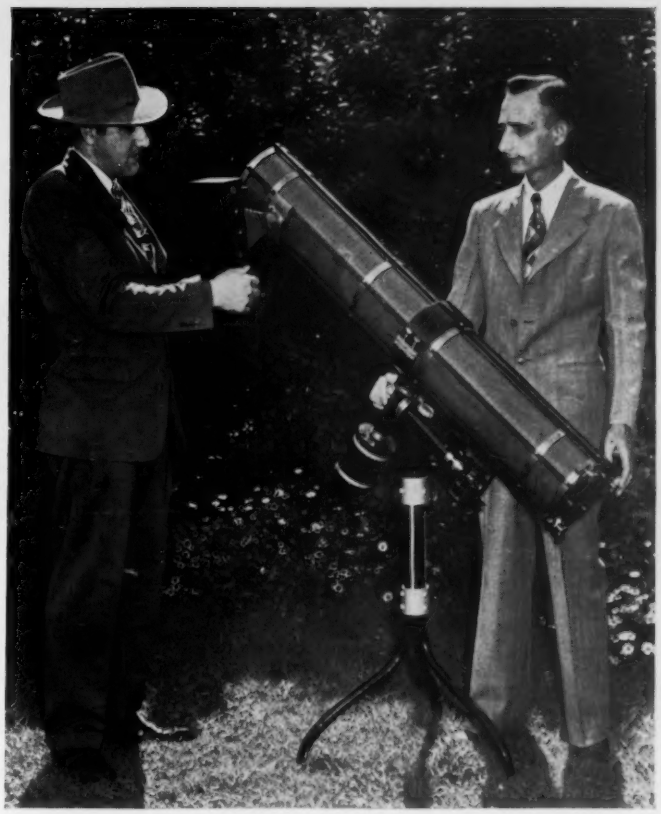
Competition may be stimulated by appointing team captains who select pick-up teams. "Constellations" finds favor with expert and novice alike and is likely to develop into a permanent feature of our informal meetings.

EDGAR M. PAULTON
A.A.A., New York City

The Astronomically Minded

Twinkle, twinkle, little star,
Now I know just what you are.
I can give you cast-iron facts
About your weight and parallax.
To me, your rate of radiation
Is simple as the earth's nutation.
Even if you're purest gas,
I can calculate your mass.
Think you're a mystery? — What a hope!
Not with my new spectroscope!

JOAN FLUX



Wilbur Wemes at left, and Herman Batt at right, with the 6-inch reflector which cost less than 20 dollars to construct. Note the tube which may be converted from the closed to the skeleton form.

LETTERS TO THE EDITOR

Sir:

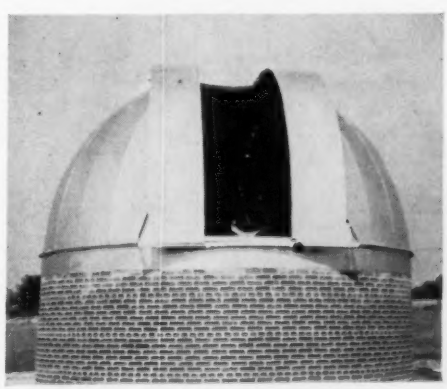
The series of articles carried last year in Gleanings for A.T.M.s on "Making Your Own Telescope" has been most helpful. To verify this statement, I enclose a photograph of my co-worker, Wilbur Wemes, myself, and my first telescope, completed last year.

I believe it should be of interest to readers of **Sky and Telescope** to know what beginners can do with a 6-inch telescope which has cost me less than 20 dollars to construct. The scope is very rigid, all steel, clock driven, with a removable paper liner which makes it a closed or open tube at will. In the picture the paper tube is in place.

With this instrument we have taken good pictures of the moon and of the eclipse of July 9th last, projecting the image into a camera attached to the eyepiece holder, as shown in the photo. The moon pictures make good 8-by-10 enlargements for study.

There is much interest in telescope making in the Owensboro Astronomy Club, recently organized here, and more instruments are in the making.

HERMAN BATT
1507 Hathaway St.
Owensboro, Ky.



The Warren County Observatory.

Sir:

Referring to the list of astronomical observatories in the United States published in your December issue, I am informing Miss Sterns of the following facts concerning observatories in this community:

Warren County Observatory. Completed June, 1939. Brick with steel revolving dome housing a 16½-inch reflector, Newtonian. Located in the Allegheny National Forest, Warren County, Watson Township, Pa. Latitude 41° 45′ north; longitude 79° 15′ west. Owned and operated by the Natural Science Section of the Warren Academy of Sciences. A photograph is enclosed.

Boy Scout Observatory. Completed in 1936. Wooden building with slide-off roof housing a 6-inch reflector, Newtonian. Located in Warren, Pa. Owned by the Warren County Council of the Boy Scouts of America. Dedicated by Dr. Charles P. Olivier of the Flower Observatory. Probably the first Boy Scout observatory in the United States.

Also, I note that you do not have any listing under Jamestown, N. Y., which should be included as follows:

Jamestown Astronomical Society Observatory. A fine 10-inch reflector housed in an observatory with revolving dome and clock drive. Write care of Bert Hanson, Hanson Electric Motor and Supply Corp., Jamestown, N. Y.

LEON LASKARIS
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Warren, Pa.

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Anyone seeking to know the world around him may with the help of the suggestions offered here follow the paths that the pioneers of astronomy trod. This popular book gives in simple language a description of everything from meteors to the solar system, tells how to make star charts and sun dials, how to identify the stars, etc. New material and numerous revisions bring the book completely up to date.

METEOROLOGY

With Marine Applications

By WILLIAM L. DONN

Formerly Head of Meteorology Section, U. S. Merchant Marine Academy

465 pages, $4.50

Although intended primarily as a textbook for marine deck officers, this important new book is at the same time a general introduction to the study of meteorology. It gives a thorough groundwork in the observation and theory of the weather elements, and then presents an extended treatment of the hurricane, with attention to modern concepts of air masses and fronts as applied to weather interpretation. A feature of the book is the list of visual aids—motion pictures and film strips—correlated with the material in the text.

Send for copies on approval

★

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★ ★ ★ ★ ★ ★ ★ ★

BOOKS AND THE SKY

ASTRONOMY

John C. Duncan. Harper and Brothers, New York, 1946. Fourth edition. 500 pages. $4.50.

THE FIRST EDITION of this textbook appeared in 1926. The second and third editions followed in 1930 and 1935, respectively. The war undoubtedly has been responsible for the delay in the publication of the fourth edition, which has just appeared. The general arrangement of the book is the same as in the third edition, except for the introduction of a concise chapter on celestial navigation, which formerly was part of the chapter on the earth (now called "Earth and Sky"). Here and there rearrangements of subject matter have been made. For example, the listing of star catalogues is given at the beginning of the chapter introducing the stars. Absolute magnitude and the principle of photometric distances are presented after the discussion of stellar magnitudes, while in the previous edition these subjects were given in the chapter dealing with the physical properties of the stars.

Considering the wealth of new material that has become available since the last edition, the author has exercised good judgment and commendable restraint in the selection of additional matter to be included in the fourth edition. The presentation of basic astronomical facts has been preserved, and has not been sacrificed for the sake of including a large mass of information of a spectacular but transitory nature. The result is a conservatism and a certain timelessness which are desirable for an elementary textbook.

The book is well printed and illustrated; many new photographs and drawings have been added. Among the more striking photographs we note the polar star trails (page 19); the precession demonstrated by Polaris (page 116); the lunar photographs taken with the Lick refractor (pages 134, 135, 138, 139); a spectrum of Cunningham's comet (page 304); the beautiful objective-prism spectra photograph by the Warner and Swasey Observatory (page 323); the photographs of the Crab nebula (page 391); the photographs in blue and red light of Orion (page 431); the intriguing photographs of a portion of the Veil nebula (page 439). Several of these are by the author and they rank among the best celestial photographs available. Of the new diagrams, we mention the action of a spherical and a parabolic mirror (pages 39 and 40); an outline map of the moon (page 137); spectra drawings in color (page 160); the orbits of Jupiter's 11 satellites (page 279). The star maps at the beginning of the book do not go beyond the 5th magnitude and are well suited for a first introduction to the constellations.

For class use, the present reviewer would like to see introduced the useful formula for the relative gravitational acceleration between two particles which is proportional to the sum of the masses and inversely proportional to the square of the distance between them. For the case of circular motion it then becomes an elementary matter to derive the expression for the sum of the masses of any two celestial bodies describing an orbit around each other (page 244). A fuller discussion of stellar interiors and of the influence of obscuring material upon the photometric interpretation of the galactic system, as outlined by stars and globular clusters, would make a desirable addition. It might be better to mention the Kapteyn star streams again in connection with the rotation of the galaxy (page 449), and it should be noted that no particularly high eccentricities are required for the galactocentric orbits in order to explain the star streams (page 353). In the chapter on the evolution of the solar system no mention is made of the binary hypothesis (1936) of Lyttleton. It is expected that in the next edition the recent promising theory of Weizsäcker (1944), explaining Bode's law, will be presented. In describing the dramatic discovery of Neptune (page 249) it should be kept in mind that a similar discovery of the companion of Sirius was made two years earlier.

The statements relating to angles and lengths (page 11) and sides and angles (page 71) are not rigorous. Figure 42 on page 51 is not convincing; it suggests a difference in exposure time rather than

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THE BOOK CORNER

Hayden Planetarium - New York 24, N. Y.

in seeing. It is regrettable that the second diagram of the orbit of Castor (page 366) differs 180° from the generally adopted orientation as seen in an inverting telescope. On page 484 the logarithm of the light ratio 2.512 is given to four decimals, where obviously no more than one decimal is warranted!

These few critical remarks are not intended to detract from the value of the book. Both as a reference and as a textbook, Duncan's **Astronomy** is warmly recommended. At the college level a student of descriptive astronomy will find in this book a reliable source, and a disciplined presentation. For the same reasons the book makes a valuable addition to the library of the serious amateur.

PETER VAN DE KAMP
Sproul Observatory

A TEXT BOOK OF ELEMENTARY ASTRONOMY

Ernest Agar Beet. University Press, Cambridge; The Macmillan Company, New York, 1945. 110 pages. $2.00.

HERE IS a neat little volume with a wealth of material, but it is not too wisely referred to as "a hand book for beginners." Anyone who begins to study astronomy needs either more or less than this book.

In his introduction, the author says that he hopes this book may supply a course of instruction more formal than the general reading already available. However, anyone who has read the general literature of astronomy and who is moved to a continuing study would be prepared for something more advanced and comprehensive than this. On the other hand, for the veriest beginner there is too little of too much. The physics of light, for example, is covered in 11 pages; the earth and its motions, in five; the constellations, in five; and so on throughout the book, with eight pages being devoted to the stellar universe, including double stars, star clusters, nebulae, the Milky Way, stellar motions, birth of stars, life on other worlds and final problems.

All of this may appear to be unduly critical of a splendid little book. There is a tremendous amount of material in it and it should be highly useful as a sort of concept-refresher text. One who has studied astronomy and who has a grasp of the fundamental principles might like to use, as the outline for his discussions in talking with learners, a volume which can easily be carried in the pocket, and this book might well be used as such a guide. To point the way for simplification of knowledge, it would be a substantial help.

There is one feature of this text which is perhaps more challenging than anything else. Observations and experiments are suggested in connection with the various topics. The experiments outlined are excellent and if the observations were followed this would be a valuable teaching aid.

At the end of the book can be found a series of questions covering the universe, and the physics involved. Anyone who can answer all of these will unquestionably have an excellent foundation in astronomy. The answers are all in the book, but if the reader were truly a beginner it would require almost word-for-word memorization to answer the questions.

ARMAND N. SPITZ
The Franklin Institute

NEW BOOKS RECEIVED

MEN, MIRRORS, AND STARS, *G. Edward Pendray*, revised edition, 1946, *Harper*. 335 pages. $3.00.

A popular history of telescopes and the men who have made them. This edition includes some added sections, new material incorporated into some of the earlier chapters, and a complete revision of the appendix material on observatories and their staffs.

YOU AND THE UNIVERSE

John J. O'Neill. Ives Washburn, Inc., New York, 1946. 328 pages. $3.50.

AN IMPORTANT DEVELOPMENT of the '20's and '30's was the increased appreciation by the public of science and its significance; this undoubtedly helped to pave the way for the unprecedented scientific applications during the war years. And deserving of much credit for this improved general knowledge is the group of trained science writers which came into existence during the same period.

John J. O'Neill was one of the pioneers in this field, starting in 1926 with the Brooklyn **Daily Eagle**, and transferring in 1932 to the New York **Herald Tribune**, where he has remained as science editor ever since. Now, as if to mark the 20th anniversary of his debut, this collection of the best of his weekly articles has been published, giving them the well-deserved permanence of a bound book.

Together these articles present a most intriguing vista of laboratory, expedition, and observatory. The variety of subjects a science editor has to cover is amazing—probably the author himself did not fully appreciate it until he began to go over his files to prepare this volume. He has divided it into two main sections: "Of Man," and "Of the Universe." Under the former heading there are articles on anthropology, archaeology, biology, zoology, physiology, medicine, and psychology. Climate, geology, mathematics, physics, electricity, engineering, chemistry, and astronomy make up the latter.

The last group, which should be of most interest to readers of **Sky and Telescope**, includes 11 articles and is typical of the treatment of other fields. There is a discussion of the structure of the galaxy, its age, the calcium clouds in interstellar space, stellar evolution, double stars, the rings of Saturn, effects of the sun on radio transmission, comets, meteorites, and the possibility of life on other planets.

Of course, by its nature, such a work as this cannot be a complete treatise on science and it is obvious that some of the theories presented may sooner or later be rejected. However, the science writer is a reporter, not a censor, and he knows from the history of science that if he were to confine himself to ideas that can never be discarded, he would stop writing entirely. So **You and the Universe** represents a broad panorama of the world about us and within us, told by a skilled narrator with imagination and understanding.

JAMES STOKLEY

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill., Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.; Tuesdays and Fridays, 8:00 p.m.

STAFF: *Director*, Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

July: LEARNING THE CONSTELLATIONS. The constellation figures are shown fitted to the stars, and easy ways of locating and recognizing the principal stars of summer are pointed out.

August: WHAT ARE STARS?

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director*, Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

July: THE END OF THE WORLD. Our world will inevitably end — someday — probably billions of years from now. Here is the dramatic story of the several ways it could happen.

August: THE END OF THE WORLD.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily; also 4 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director*, Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

July: UNDER SUMMER SKIES. With more leisure, and warm summer nights, you too can begin to enjoy the stars. How to go about it is the question answered in this demonstration.

August: FROM POLE TO POLE.

GRIFFITH PLANETARIUM

P. O. Box 9866, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Friday and Saturday, 3 and 8:30 p.m.; Sunday at 3, 4:15, and 8:30 p.m.

STAFF: *Director*, Dinsmore Alter (on military leave). *Acting Director*, C. H. Cleminshaw. *Other lecturer:* George W. Bunton.

July: COMETS AND METEORS. The development of a spectacular comet, moving slowly among the stars and pointing its tail always away from the sun, and a shower of meteors, will be shown.

August: JUPITER AND VENUS.

HAYDEN PLANETARIUM

81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator*, Clyde Fisher. *Chairman and Curator*, Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

July: BIRTH OF THE SOLAR SYSTEM. How did it all begin? What theories have suggested themselves regarding the origin of the solar system? These are discussed in July under the planetarium skies.

August: END OF THE WORLD.

OBSERVER'S PAGE

Greenwich civil time is used unless otherwise noted.

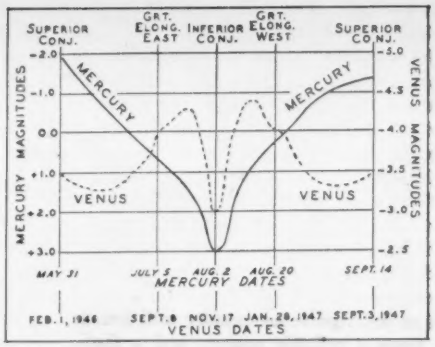
THE VISIBILITY OF THE PLANETS — II

THE VISIBILITY of Venus differs much from that of Mercury although they are both inferior planets. Even at inferior conjunction with the sun, Venus may be still very bright, about −3 magnitude, and its total variation during one synodic period is only about 1½ magnitudes, whereas Mercury may vary through five magnitudes. Thus, in the accompanying diagram, the vertical scale for Venus is half as great as it is for Mercury.

The synodic period of Venus is much longer, 584 days as against Mercury's 116, so Venus' magnitude changes are very much slower. The scale of time on the chart (horizontal) is five times as great for Venus. The bright planet has the smallest eccentricity for any planet; therefore the form of the light curve is almost identical for every period. The graph is for this year and most of the next.

After passing superior conjunction, Venus becomes visible in binoculars 15 to 20 days later if this occurs some time between December and June. From July through November, the sun is higher (or the ecliptic lower after sunset) and the planet cannot be seen in this fashion for 40 days. Conditions are just reversed in the Southern Hemisphere. This year, with conjunction on the 1st of February, the writer easily saw the planet on February 21st. The time was just after sunset and Venus was very low where the sun had gone down. Two weeks after this, it was visible to the naked eye. The same conditions will not be repeated until the spring of 1949.

Venus' light curve shows that at superior conjunction the planet is slightly brighter than for a period several months later. This is because the entire disk of the planet is visible at conjunction while later it has taken on a gibbous phase and the distance is only slightly less. After this decrease, the planet slowly increases in brightness as it approaches elongation. At greatest elongation east, Venus may set 4½ hours after the sun in mid-northern latitudes in the spring. In the morning sky (western elongation) autumn is most favored. At these times, Venus appears as a brilliant white object of magnitude −4.0, outshining all other stars and planets by far. This year Venus is unfavorably situated for northern observers as eastern elongation occurs in the fall. The sun is north of the planet, so from southern latitudes Venus is excellently placed for observation some hours after sunset.

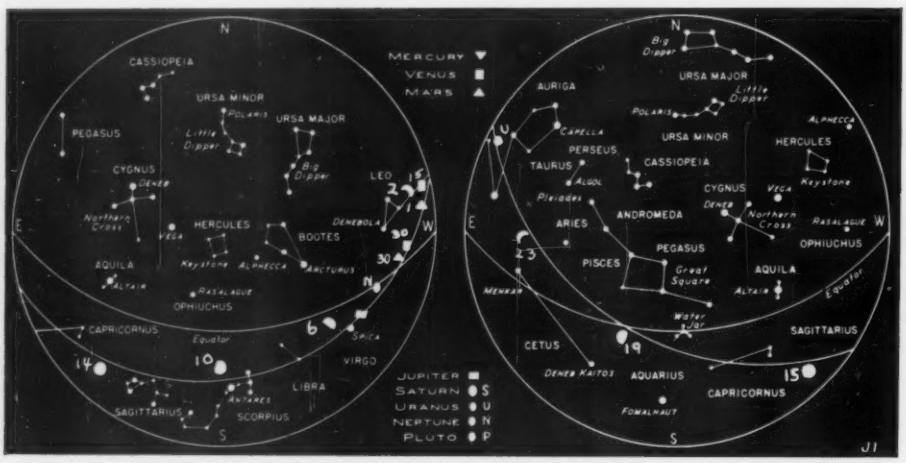


This chart, comparing the changes in brightness of Venus and Mercury, is the same as that used last month.

Near elongation, Venus can be easily seen at noontime with the naked eye if you look in the proper place. A crescent moon nearby is of great aid in locating the planet.

After elongation, Venus begins to approach the sun in the sky. The most interesting part of its synodic period occurs in the 144 days between eastern and western elongation, inferior conjunction coming halfway between. Greatest brilliancy occurs 36 days after elongation, and the same number of days before inferior conjunction. Then the planet's

THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES



In mid-northern latitudes, the sky appears as at the right at 3:30 a.m. local time on the 7th of the month, and at 2:30 a.m. on the 23rd. At the left is the sky for 9:30 p.m. on the 7th and 8:30 p.m. on the 23rd. The moon is shown for certain dates by symbols which give roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.

Mercury is visible as a 1st-magnitude object in the evening sky for the first half of this month. Greatest elongation occurs on July 5th, when Mercury is 26° east of the sun and sets 1½ hours after sunset.

Venus passes 1° north of Regulus on July 13th. Venus is on the descending part of the ecliptic as seen by northern observers and is becoming less favorable for observation. The planet sets only two hours after the sun even though it is 40° distant and nearly at greatest elongation. Its magnitude is −3.6.

Earth is at aphelion, maximum distance from the sun, on July 3rd. This distance, based on the standard solar parallax of 8″.80, will be 94,452,000 miles.

Mars is now inconspicuous in the evening twilight.

Jupiter is on the meridian near sunset and sets four hours later. It is situated about 5° northwest of Spica.

Saturn is in conjunction with the sun on the 21st. This is the only month in 1946 when Saturn is not visible to the naked eye.

Uranus will be visible before dawn by the end of the month, near the horns of the Bull. On the 20th it is at 5h 16m, +23° 7′, and on the morning of the 25th, the planet will be just off the northern limb of the crescent moon — an excellent opportunity to see Uranus.

Neptune is approaching too near the sun for observation.

E. O.

JUPITER'S SATELLITES

Jupiter's four bright moons have the positions shown below for the GCT given. The motion of each satellite is from the dot to the number designating it. Transits of satellites over Jupiter's disk are shown by open circles at the left, and eclipses and occultations by black disks at the right. Reproduced from the American Ephemeris and Nautical Almanac.

Configurations at 3h 15m for an Inverting Telescope

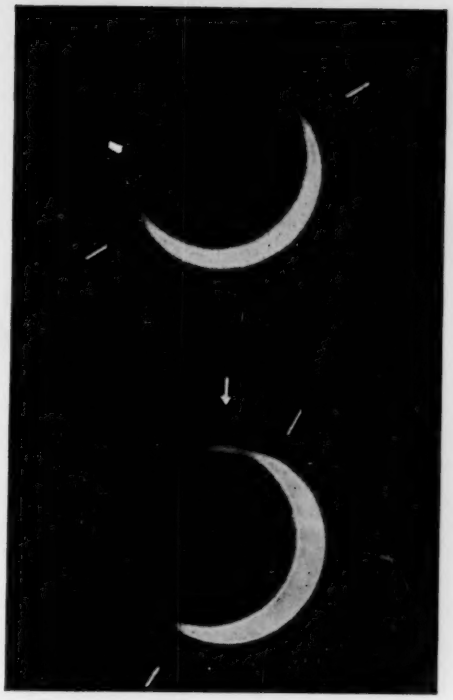
Day	West	East
1	4·	3· ·○2 ·1
2	·4	3· ·1 ○ 2·
3	·4	·3 2·○ 1·
4	·4	·2 ·1○3
5	○1·	·4 ○ ·2 ·3
6		·○4 2· 3· ·1●
7		2· 1· ○ 3· ·4
8		3· ·2○ ·1 ·4
9		3· 1· ○ ·2 ·4
10	○2·	3· ○ 1· ·4
11		·2 ·1 ○ 4· ·3●
12		○·2 ·3 4·
13		○ 2· ·1●
14		2· 1·○ 4· 3·
15		○ ·1
16		1· ○ ·2
17	4·	·3 2○ 1·
18	4·	·2 ·1 ·○3
19	·4	○ 1· ·3 ·2●
20	·4	·○1 2· ·3
21	○1·	·4 2· ○ 3·
22		·4·2 3· ○ ·1
23		3· 1· ○·4 ·2
24		·3 ○2· ·1 ·4
25		2· ○ ·4
26		○ 1· ·3 ·4 ·2●
27		·1○ 2· ·3 ·4
28		2· 1○ 3· 4·
29	○3·	·2 ○ 4· ·1●
30		3· 1· ○ ·2 4·
31		·3 ○4·

brightness drops rapidly, usually about 1½ magnitudes. This is the period when Venus approaches closest to the earth, within about 26 million miles. The disk of the planet is one minute of arc across and the crescent is easily visible in binoculars or even to the unaided eye a few days before inferior conjunction.

The planet has been seen in field glasses exactly at conjunction. If this event takes place in March or September, Venus can be as much as 9° from the ecliptic, and thus can be followed for a time close to conjunction. In March conjunctions Venus would be north of the sun, while in September it would be to the south. Hence, in March inferior conjunctions, Venus may be above the horizon after sunset in northern latitudes and can possibly be seen with the naked eye. Of course, at this time, the planet appears as an extremely thin crescent, with the horns of the crescent extending well around the disk when observed with sufficient optical aid.

After inferior conjunction, Venus repeats the same phases and changes in magnitude but just in reverse, until superior conjunction 9½ months later: greatest brilliance in the morning sky 36 days after inferior conjunction, then western elongation, and the slow traverse back to superior conjunction.

EDWARD GRAVEC



Photos of Venus near inferior conjunction (taken in daylight) reveal the extension of the horns of its crescent by refraction in its atmosphere. Lowell Observatory photo.

OCCULTATION PREDICTIONS FOR JULY

This month finds two 3rd-magnitude stars, Beta Scorpii and Lambda Sagittarii, hidden behind the moon, although it will be practically full moon in the latter instance. Of more interest for observers in Texas and the southwestern United States is the practically simultaneous occultation of Beta Scorpii and 56 B Scorpii early on the morning of July 10th.

The positions of these stars for 1946.0 as given in the **American Ephemeris** are: Beta Scorpii, 16h 02m 17s.565, −19° 39′ 33″.22; 56 B Scorpii, 16h 02m 17s.921, −19° 39′ 20″.45. There should be no trouble in identifying the fainter star to the north of the bright one as the moon approaches them prior to the occultation. With a stop watch one might attempt timing the exact interval between their respective immersions for his local station. Of more scientific value, of course, is determination of the exact time of each immersion (or emersion) by means of carefully checked timepiece or chronometer. The editors will be glad to refer serious-minded occultation observers to the proper professional advisors.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, limiting parallels of latitude, immersion or emersion; standard station designation, GCT, a and b quantities in minutes, position angle; the same data for each standard station westward.

Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	**E** +91°.0, +40°.0
B +73°.6, +45°.6	**F** +98°.0, +30°.0
C +77°.1, +38°.9	**G** +114°.0, +50°.9
D +79°.4, +43°.7	**H** +120°.0, +36°.0
I +123°.1 +49°.5	

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

For additional occultations consult the American Ephemeris and Nautical Almanac and the British Nautical Almanac, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.

9-10 **47 Librae m** 5.9, 15:51.9 −19-13.5, 11, +71° +22° Im: **A** 1:33.2 −1.3 −1.4 148°; **B** 1:28.0 −1.3 −1.0 144°; **C** 1:33.6 −0.9 −2.0 164°.

9-10 **Beta Scorpii** 2.9, 16:02.3 −19-39.6, 11, +71° −1° Im: **F** 8:05.0 −0.7 −1.1 90°; **H** 7:35.1 −1.8 −0.4 66°. Em: **F** 9:11.5 −0.3 −1.5 288°; **H** 8:39.0 −1.5 −2.7 323°.

9-10 **56 B Scorpii** 5.1, 16:02.3 −19-39.3, 11, +71° −1° Im: **F** 8:05.4 −0.7 −1.1 89°; **H** 7:35.6 −1.7 −0.3 65°. Em: **F** 9:11.5 −0.3 −1.5 289°; **H** 8:38.7 −1.5 −2.7 325°.

12-13 **Lambda Sagittarii** 2.9, 18:24.6 −25-27.2, 14, +65° +10° Im: **A** 0:52.3 −1.1 +0.9 103°; **C** 0:45.3 −0.8 +0.5 117°; **E** 0:40.3 0.0 +0.1 134°. Em: **A** 2:13.6 −1.8 +0.6 278°; **B** 2:13.5 −1.6 +0.6 281°; **C** 2:02.4 −1.9 +1.0 267°; **D** 2:03.0 −1.6 +1.0 273°; **E** 1:40.7 −1.5 +1.8 251°.

17-18 **257 B Aquarii** 6.3, 22:56.7 −13-21.6, 19, +77° +26° Em: **A** 6:45.4 −1.0 +2.2 197°; **B** 6:50.4 −1.0 +1.8 204°; **C** 6:32.4 −1.0 +2.5 197°; **D** 6:40.7 −1.2 +2.0 208°; **E** 6:19.3 −1.1 +2.3 211°; **F** 5:42.7 −1.1 +4.0 183°.

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown. To convert standard time to daylight saving time, add one hour.

METEOR SHOWERS

Meteor activity, which has been quite slow since January, picks up greatly in July and continues through autumn and until early January. From July 25th to 30th, the Delta Aquarids are at maximum. The rates are high and gratifying results should be had from several hours of observing. The moon is, fortunately, near the new phase. These meteors are generally slow with long paths, and there are many bright ones with trains. The radiant is given as 22h 36m, −11°.

When observing the Delta Aquarids, you may notice many meteors coming from the northeast. These are from the Perseid shower which begins about July 15th. After true midnight, more meteors will be seen, especially these Perseids, for which the radiant in July is in Andromeda near M31. The radiant moves through Perseus at maximum on August 12th and then into Camelopardalis. The Perseids are very swift with many bright members of the shower. As a full moon spoils the maximum this year, the best observing will be done in late July and the first week of August.

E. O.

VARIABLE STAR MAXIMA

July 6, T Normae, 7.4, 153654; 9, RR Scorpii, 6.0, 165030a; 10, R Ursae Majoris, 7.6, 103769; 12, R Bootis, 7.3, 143227; 16, R Corvi, 7.6, 121418; 18, R Cassiopeiae, 6.5, 235350; 29, R Leonis, 5.9, 094211.

These predictions of variable star maxima are made by Leon Campbell, recorder of the A.A.V.S.O., Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

PHASES OF THE MOON

First quarter	.....	July 6, 5:15
Full moon	.....	July 14, 9:22
Last quarter	.....	July 21, 19:52
New moon	.....	July 28, 11:53

MINIMA OF ALGOL

July 3, 00:30; 5, 21:19; 8, 18:08; 11, 14:56; 14, 11:45; 17, 8:33; 20, 5:22; 23, 2:11; 25, 22:59; 28, 19:48; 31, 16:36.

(Other observer's notes on page 20.)

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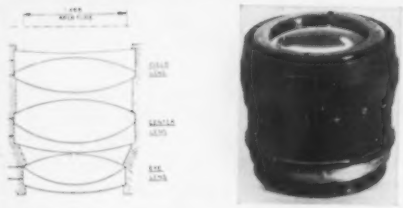

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GLEANINGS FOR A. T. M.s

Detroit Observatory and Clock Drive

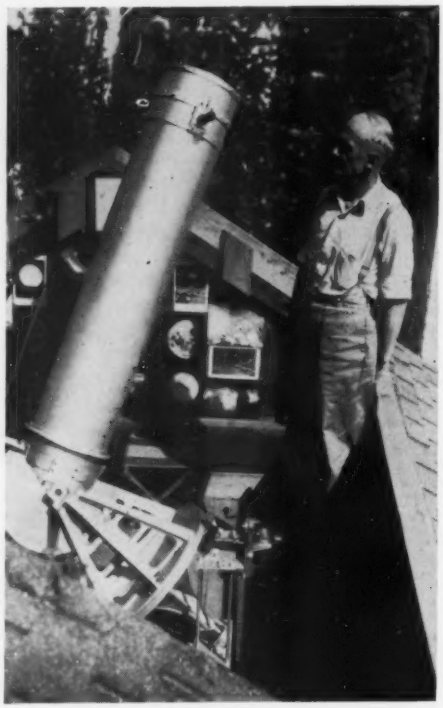
AN AMATEUR telescope maker likes to dream and look forward to the time when his instrument will be equipped with a clock drive, so the telescope will automatically follow the stars across the sky. Max Bartholomew, of 13612 Kentucky Ave., Detroit, Mich., an instructor in the Henry Ford trade school, went to work and made a clock drive based on a rearrangement of an old phonograph windup spring motor.

The observatory platform is on top of the garage, half of the roof sliding back on rollers over the other half. The telescope is a 10-inch reflector with a focal length of 83 inches. The tube, made of sheet iron soldered together and braced with old auto brake drums, is mounted in a trunnion. This permits rotation of the tube for the convenience of the observer.

The equatorial mounting is of one single aluminum casting. Its bottom plate is 23 inches in diameter, and coming up from this plate are two triangular three-pronged forklike extensions, 20 inches high. At the top of these prongs are openings for the declination shaft on which the telescope tube is balanced. The whole equatorial mounting is suspended on roller bearings, all made with unusual mechanical skill, so the telescope can be moved by the merest touch.

The spring motor was removed from an old-fashioned talking machine. The governor and brake were kept and continue to be used in the present arrangement. The spring motor revolved at the rate of 27 revolutions per minute, which had to be reduced to turn the mounting once in 24 hours to provide the right-ascension motion. Two gears and two worms were used, one gear of 50 teeth and the other of 60 teeth. Motion is transferred from the spring motor to the reducing arrangement by a short piece of auto speedometer cable. This permits a considerable amount of flexibility. The metal frame carrying the gear shafting and worms is suspended on uprights, so as to allow the whole device to be tilted back and forth.

The reducing device ends in a hard rubber wheel, 1¾ inches in diameter, mounted on the end of the final piece of shafting. It is this rubber wheel that makes contact with the equatorial mounting by friction and pressure, as the whole frame of the reducing mechanism is tilted forward or backward. A screw adjustment controls the position of the rubber wheel, so that



Max Bartholomew and his 10-inch reflector. Note the "fork" mounting, and the small rubber wheel which transmits the clock motion to the large disk on the polar axis. The handle for winding up the phonograph motor is visible.

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the drive may be disengaged if desired.

A star under observation with this telescope will remain in the field for an entire evening, but, of course, it will not stay on the crosshairs. The arrangement is splendid for direct visual work, but for photography some device for correction of declination must be added. The spring motor requires winding every 20 minutes.

Formerly the clock mechanism was attached to a 7-inch reflector of 54-inch focal length. This smaller instrument was readily portable. The present telescope is semiportable. In about an hour's time, it can be taken down and set up in a park for an evening of public observation.

Mr. Bartholomew is an active member of the Detroit Astronomical Society, and has served a term as vice-president of that group.

C. S. JOHNSON
Detroit, Mich.

WELL-EQUIPPED COLORADO OBSERVATORY

AS ORIGINALLY BUILT in 1933, there were two rooms in John Bunyan's observatory at Berthoud, Colo., the smaller one, 6 by 8 feet, housing a small meridian telescope, a sidereal clock, short-wave radio for time signals, a working desk and bookshelf. The larger room, 12 by 12 feet, housed a 10-inch Cassegrainian reflector on an equatorial mounting, equipped with circles and electric motor drive.

A general view of the observatory of John Bunyan. The nearest room (right) contains a meridian telescope.

In 1941, a room 8 by 12 feet was added and a photographic unit installed on a sturdy equatorial mounting, equipped with circles and electric drive. There are two cameras, built by Mr. Bunyan, one with a 4-inch Voigtlander lens of 25-inch focal length, and the other with a 2-inch f/5 Bausch and Lomb lens. The whole assembly was designed by him and built with the help of a local mechanic. A Synchron motor, made by the Hanson Manufacturing Company, Princeton, Ind., furnishes the timing and acts as a brake through means of reduction gearing against the pull of a sash weight and cord over a pulley on the equatorial axis. The

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12. Telescope quickly detachable from clamping blocks.
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16. Shipped adjusted to your latitude, with the mounting height made to suit a reflector or a refractor.

Portable sidereal clock — $30.00

These mountings are constructed at very lowest cost and sold at small profit. There are three sizes: small for 4" to 10" telescopes; medium for 12" to 16"; large for 16" to 24". Prices are in proportion to size.

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motor is geared to one revolution per minute and spur gears are used to build up a ratio of 364 to 363 to approximate the sidereal rate (as nearly as could be done with stock gears).

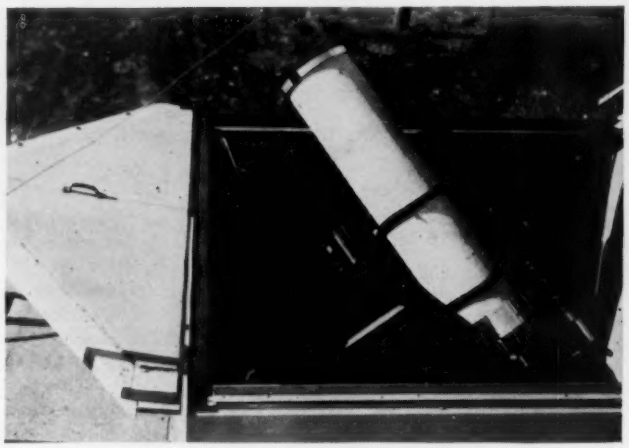
The 10-inch reflector, the two cameras, and a 3-inch Brashear refractor for guiding are now mounted upon the declination axis of the photographic assembly, as shown in the accompanying picture.

In April, 1944, a Brashear refractor, with an object glass of 5½-inch clear aperture and a focal length of 66 inches, was secured, and was put on the equatorial mounting in the main room which formerly carried the reflector. It is a fine instrument, and very handily splits the double double of Epsilon Lyrae.

The sidereal clock is very closely compensated for temperature; an article on it appears on pages 425-6 of **Amateur Telescope Making Advanced.**

The roofs of the main room and the camera room roll off to the north, and the south gable of the camera room, mounted on hinges, lets down onto a post. There are hatches in the roof of the small room to allow use of the meridian telescope. A star transit can be observed about to the nearest second of time.

Mr. Bunyan, who is president of the Berthoud National Bank, devotes a part of his evenings on good nights to observing and to photographing star fields and constellations. He has a fine set of slides, most of them from Mount Wilson, and a projector, and has given many lectures on astronomy.



The 10-inch Cassegrainian telescope of John Bunyan's observatory. The same mounting carries a camera lens and a 3-inch refractor for guiding. Note the manner in which the hinged gable lets down out of the way.

SKY-GAZERS EXCHANGE

Classified advertisements are accepted for this column at 40 cents a line per insertion, six words to the line. Minimum ad is three lines. Remittance must accompany orders. Address Ad Dept., Sky and Telescope, Harvard Observatory, Cambridge 38, Mass.

FOR SALE: 10″ mirror mounted in cell, focal length 80″. Needs resilvering, otherwise excellent. Also adjustable revolving eyepiece mount, can be adapted to any 10″ tube. Mount includes 1½″ prism. Satisfaction guaranteed. Price $85.00 plus shipping charge. Robert C. Holland, 118 Newton St., Meriden, Conn.

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VENUS OCCULTATION OBSERVED IN TEXAS

Gene Bonnell, of Hooks, Tex., latitude 33°.5 north, longitude 94°.3 west, reports observing the occultation of Venus on the evening of June 1st. He writes in part:

"Computations made last September indicated that it would be visible here although this occultation was not listed for any of the standard stations except the one at longitude 120 degrees. First contact was not timed, but occurred an estimated 45 seconds before second contact, which was at 6:31:56 p.m. [presumably CST]; third contact, 7:17:26; fourth, 7:18:21. No unusual band or other effects were noted. My computations were 6:31:42 for immersion and 7:18:12 for emersion, which compares well with the actual times.

"Venus and the moon were located in the telescope by 6:15 p.m., and the moon first seen with the naked eye after immersion, at 6:40. The sun set behind trees at 7:12 p.m. The emersion was clearly visible to the naked eye, and the ensuing spectacle provoked considerable comment, including a front-page story in the local (Texarkana) paper the next morning."

CONJUNCTIONS IN JULY

During early July, it may be interesting to note along 65° of the ecliptic six bright objects starting from Mercury, in Cancer, lowest in the west. Above are Venus, Regulus, and Mars in Leo, Jupiter and Spica in Virgo. The crescent moon will pass these objects on June 30th, July 1st, 2nd, 3rd, and 6th for the last two, respectively. In every conjunction the moon will be to the north, as its maximum distance north of the ecliptic occurs in this portion of its orbit. E. O.

T CORONAE BOREALIS BECOMES BRIGHTER

According to A.A.V.S.O. observers, the remarkable recurring nova, T Coronae Borealis, is increasing in brightness to a secondary maximum. The first hint came from D. W. Rosebrugh, of Waterbury, Conn., who reported the star to be of magnitude 9.3 on May 31st. This was followed by an observation on June 1st, when W. S. Houston, of Moundville, Ala., found the star's brightness to be 8.3.

Since the star's outburst on February 9th, nearly 400 estimates of brightness have been made at one station or another, and for the first 90 days only five nights were missed in the observation of the variable.

A comparison of the 1946 light curve with that of 1866 shows a remarkably close agreement in form and brightness. Although the 1866 maximum appears to have been slightly brighter, the decrease to minimum and the behavior at minimum follow an almost identical pattern. The current rise appears quite consistent with that part of the 1866 increase to a secondary maximum. With notification of the recent increase having been sent to special observers, we expect to ascertain the exact behavior of the star throughout the present secondary maximum.

LEON CAMPBELL
Recorder, A.A.V.S.O.

June 7, 1946

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RIGHT ANGLE PRISM—Flint Optical Glass, size 41 mm. by 91 mm. by 64 mm. Use in front of camera Lens to take pictures to right or left while pointing camera straight ahead. Also used in front of camera Lens to reverse image in direct positive work. Two of these Prisms will make an erecting system for a Telescope.
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ALL THE LENSES YOU NEED TO MAKE YOUR OWN TELESCOPE!

ALL ARE ACHROMATIC LENSES

GALILEAN TYPE — Simplest to Make but has Narrow Field of View.
Stock No. 5004-Y—Small 2 Power Pocket Scope .....**$1.00 Postpaid**
Stock No. 5018-Y—4 Power Telescope, **$1.25 Postpaid**

PRISM TELESCOPES—Use Prism instead of Lenses to Erect Image. Have wide field of view.
Stock No. 5012-Y—20 Power Telescope, **$7.25 Postpaid**

ACHROMATIC LENSES

Stock No.	Dia. in mms.	F.L. in mms.	Price
6158-Y*	18	80	$1.00
6162-Y	25	122	1.25
6164-Y*	26	104	.80
6166-Y	29	54	1.25
6168-Y	29	76	1.25
6171-Y	32	171	1.00
6173-Y*	34	65	1.00
6176-Y*	38	131	1.00
6177-Y*	39	63	1.10
6178-Y*	45	189	1.50
6179-Y*	46	78	1.25
6182-Y	27	51	1.25
6183-Y	44	189	2.50

*ASTERISKED ITEMS are uncemented, but FREE cement and Directions included with uncemented sets.

USES:—Use these Lenses for making Projecting Lenses, Low Power Microscope Objectives, corrected Magnifiers, substitute enlarging Lenses, Eye-Piece Lenses, Macro-photography, Gadgets, Optical Instruments, etc., etc.

MOUNTED PROJECTION LENS

A mounted f 2.1; 3.5 inch F.L. Projection Lens mfgd. on a Navy contract to be used on a 35 mm. Projector. Low reflection coated. Perfect condition. Black finish threaded at rear end. Outside diam. approx. 2 inches.
Stock #4031-Y ..... $12.00 Postpaid

POLARIZING FILTER—Diam. 73 mm. Perfect condition.
Stock #637-Y ..... $3.00 Postpaid

GIANT SIZE RED AND AMBER FILTERS

Filter material is cemented between glass. All ¾" thick.

Stock No.	Color	Diam.	Price
706-Y	Red	7-7/8"	$4.00
707-Y	Red	5-7/8"	3.00
708-Y	Amber	7-7/8"	3.00
709-Y	Amber	5-7/8"	2.00

WE HAVE LITERALLY MILLIONS OF WAR SURPLUS LENSES AND PRISMS FOR SALE AT BARGAIN PRICES. WRITE FOR CATALOG "Y"— SENT FREE!

PRISMS

Stock No.	Type	Base Width	Base Length	Price
3040-Y	Right Angle	33 mms.	23 mms.	$1.25
3053-Y	Right Angle	70 mms.	168 mms.	3.00
3001-Y	Lens Surface	20 mms.	14 mms.	2.00
3006-Y	Porro-Abbe	9 mms.	9 mms.	.25
3009-Y	Porro	52 mms.	25 mms.	1.00
3029-Y	Dove	16 mms.	65 mms.	1.25
3036-Y	80 Degree Roof	60 mms.	36 mms.	4.00
3038-Y	Roof Prism	18 mms.	34 mms.	2.50

RAW OPTICAL GLASS

An exceptional opportunity to secure a large variety of Optical Pieces both Crown and Flint glass (seconds) in varying stages of processing. Many prism blanks.
Stock No. 703-Y—8 lbs. (min. wt.)—**$5.00 Postpaid**
Stock No. 702-Y—1½ lbs. .....**$1.00 Postpaid**

LENS CLEANING TISSUE—In spite of paper shortage, we offer an exceptional bargain in first quality Lens Cleaning Tissue. You get 3 to 4 times as much tissue as when you buy in the ordinary small booklets. One ream—480 sheets—size 7¾" x 10¾".
Stock No. 704-Y ..... $1.50 Postpaid

MISCELLANEOUS ITEMS

Stock No.	Item	Price
3006-Y	Porro Abbe Prism	$0.25 each
2024-Y	10 Pieces Circular A-1 Plate Glass (Diam. 31 mm—for making Filter)	.25
3021-Y	Amici Roof Prism (3rd Grade)	.25 each
523-Y	Six Threaded Metal Reticle Cells	.25
624-Y	Neutral Ray Filter size 4¾" x 2½"	.25
3022-Y	Round Wedge 65 mm. diam. ..	5.00 each
16-Y	Level Vial, 48 mm. long	.20 each
1040-Y	6 Power Magnifier—diam. 25 mm.	.25 each
2043-Y	Standard Crossline Reticle—diam. 29 mm.	.50 each
1034-Y	Burning Glass Lens	.25 each
535-Y	Small First Surface Mirror ..	.30
3003-Y	Amici Roof Prism with Corrected Roof	2.50
633-Y	Combination Polarizing and Infra-Red Filters, diam. 20 mm.	.50

(Minimum Order on Above—$1.00)

TANK PRISMS

PLAIN OR SILVERED

90-45-45 deg. 5¾" long, 2⅛" wide, finely ground and polished.

Stock #3004-Y Silvered Prism (Perfect) .. **$2.00 Postpaid**

Stock #3005-Y Plain Prism (Perfect) .. **$2.00 Postpaid**

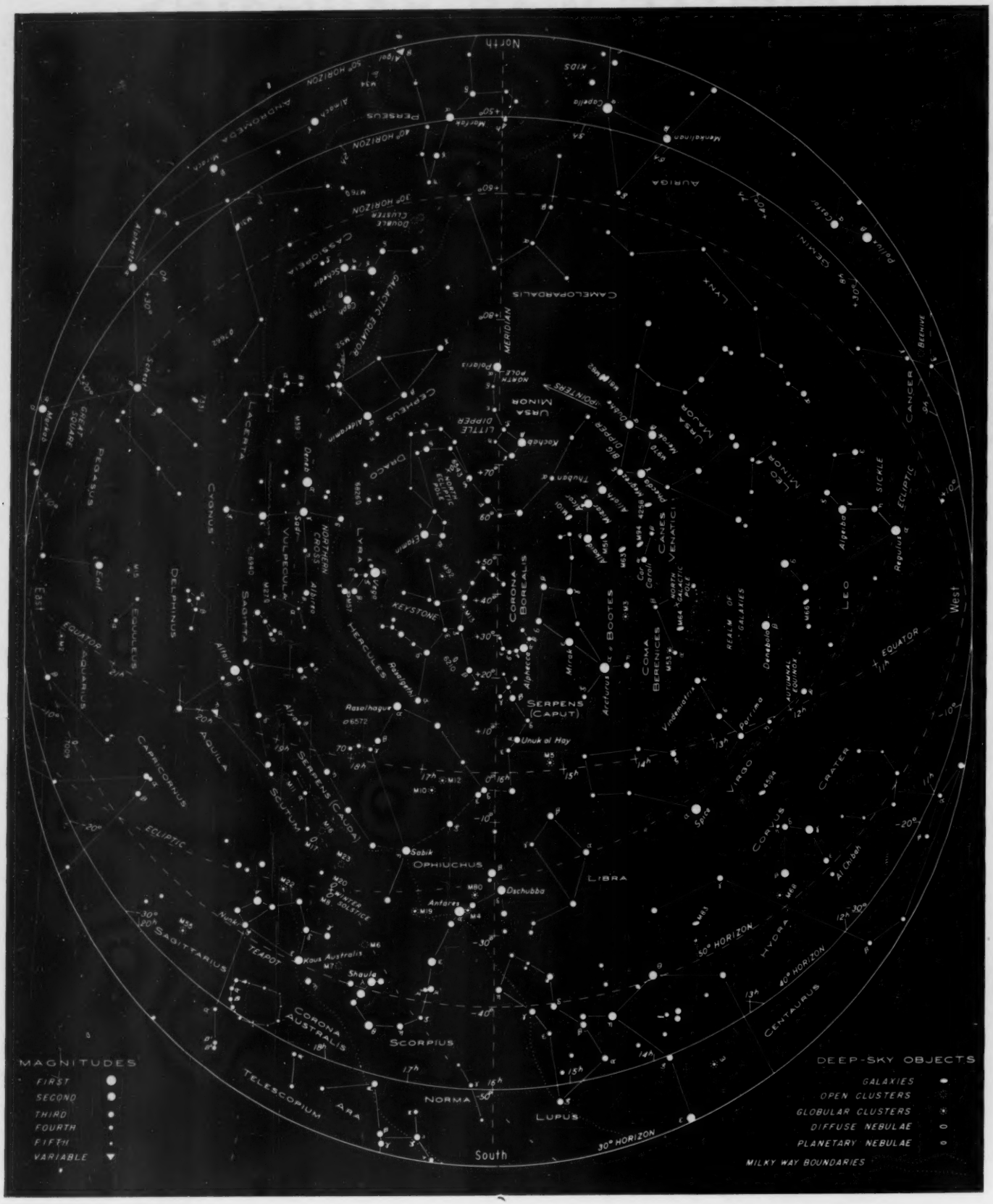
Stock #3100-Y Silvered Prism (Second) ... **$1.00 Postpaid**

Stock #3101-Y Plain Prism (Second) ... **$1.00 Postpaid**

(Illustrated Book on Prisms included FREE)

ORDER BY SET OR STOCK NO. • SATISFACTION GUARANTEED • IMMEDIATE DELIVERY

EDMUND SALVAGE COMPANY + P. O. AUDUBON, NEW JERSEY



DEEP-SKY WONDERS

NIGHT SKIES of July invite us to hunt for globulars. Besides M3 in Canes Venatici, M13 and M92 in Hercules, and M5 in Serpens Cauda, we can select from the 31 globulars in and around Sagittarius — nearly one third of the total known. Suggested are the following:

Ophiuchus. M12, $16^h\ 44^m.3$, $-1°\ 51'$. M10, $16^h\ 54^m.3$, $-4°\ 01'$. M19, $16^h\ 59^m.2$, $-26°\ 11'$. M14, $17^h\ 34^m.8$, $-3°\ 13'$.

Scorpius. M80, $16^h\ 13^m.8$, $-22°\ 51'$. M4, $16^h\ 20^m.3$, $-26°\ 24'$. M62, $16^h\ 57^m.8$, $-30°\ 02'$. NGC 6388, $17^h\ 32^m.3$, $-44°\ 42'$.

Libra. NGC 5897 (19^6), $15^h\ 14^m.3$, $-20°\ 49'$.

Lupus. NGC 5986, $15^h\ 42^m.4$, $-37°\ 36'$.

Sagittarius. M28, $18^h\ 21^m.2$, $-24°\ 54'$. And majestic M22, $18^h\ 33^m$, $-23°\ 58'$. Three small globulars: M69, $18^h\ 27^m.7$, $-32°\ 23'$; M70, $18^h\ 39^m.6$, $-32°\ 21'$; M54, $18^h\ 51^m.6$, $-30°\ 33'$.

L. S. COPELAND

STARS FOR JULY

from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.

EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Sept. 7th at 11 p.m., Sept. 23rd at 10 p.m., October 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of alternate months, August, 1944, to June, 1945, and September, 1945, to the present.